STUDIES ON TREMATODE PARASITES OF CERTAIN FRESH WATER FISHES OF BUNDELKHAND REGION

THESIS

Submitted for the Award of the Degree of

Doctor of Philosophy

in

ZOOLOGY

Under the Faculty of Science

of the

Bundelkhand University, Jhansi

BY

Arvindra Kumar Yadav,

M. Sc.

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BIPIN BEHARI (P. G.) COLLEGE

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T H E S I S

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Under the Faculty of Science

of

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JHANSI

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CERTIFICATE

Certified that the thesis entitled, "Studies on Trematode Parasites of Certain Fresh-Water Fishes of Bundelkhand Region," submitted by Mr. Arvindra Kumar Yadav, M.Sc.(Zoology) for the degree of DOCTOR OF PHILOSOPHY (Ph.D.) in the subject ZOOLOGY under the Faculty of Science of the BUNDELKHAND UNIVERSITY, JHANSI embodies the original work done by him. He has worked under my guidance and supervision for morethan twenty four months, commencing from the date of his registration.

It is further certified that the candidate has put in an attendance of over 2oo days in this department from the date of his registration for the Ph.D. degree of the Bundelkhand University as required under relevant ordinances.

(U. K. DWIVEDI)
Supervisor

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Nov., 1995. (Arvindra Kumar Yadav)

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PART - I

INTRODUCTION

Fishes occupy an important place in human diet, economy and ecosystem. Like other vertebrates, fishes too harbour parasitic population of diverse group of helminth parasites, which have detrimental effect on t e fishes in many ways like stunted growth, postponement of sexual maturity, damage to various organs thus affecting the yield of fish production. The study of fish pathology is of much importance both from the point of view of fishery management and also to check the spread of human and animal diseases for which fishes act as carriers. The success of implementation of avrious fishery development programmes deponds to a certain extent on the intensification of fish parasitological research, as the improvement of fish production can be achieved from healthy fish stock only.

During the last five decades, lot of work has been done on the morphology and taxonomy of parasites of fishes. These researches have contributed a lot to our knowledge of many genera and species, both known and new. Still our knowledge on fish parasites and disease is very meagre and we have no knowledge of the amount of damage caused and loss incurred in total fish production and fish products due to parasites and parasitic diseases.

In Uttar Pradesh and Madhya Pradesh too, ambitious projects are being launched to develop inland fisheries. But little work has been done on the parasites of fishes particularly from Bundelkhand region. Keeping this in view, the present study was undertaken and attempt has been made to fill a part of the wide lacuna left in this field.

Bundelkhand region is considered to be a premier region of the country, because it has a number of small and large water bodies, lakes, dams and two rivers which provide better fisheries and aquaculture prospects. All these water bodies are rich in fish fauna.

The Bundelkhand region forms South-east boundry of Uttar Pradesh, extending from 24.21' to 26.42' North latitude and 78.14' to 81.38' East longitude. It is comprised of five districts, namely - Jhansi, Lalitpur, Jalaun, Hamirpur and Banda. The region is surrounded in northern side by the districts of Etawah, Kanpur, Fatehpur and Allahabad of Uttar Pradesh; in Western side by the districts of Guna, Shivpuri and Datia of Madhya Pradesh, and in Southern side by the districts of Sagar, Chattarpur Panna of Madhya Pradesh.

The river Betwa and river Ken are two of the major rivers of the region. In the Bundlkhand region a number of large and small dams are also present which are a good source of inland fisheries. The main dams are - Jamni dam, Sagnam dam, Rohni dam, Rjghat dam, Matatila dam, Dhukwan dam, Shahzad dam, Saprar dam, Pahuj dam, Khaprar dam, Dongri dam, Maudaha dam, Arjun dam, Kabrai dam, Barwa dam, Gunta dam, Pathra dam, Parichha dam, Pahari dam, Keolari dam, Chandrawal dam. A number of rivulets, large number of ponds, pools and irrigation canals and drains constitute considerably rich fresh-water resources for inland fisheries. The daily fish-output from this region is 30 to 40 metric tons in off season and 50 to 80 metric tons during the season. The whole collection is exported to different important areas of the country after satisfying the regional requirements. All popular groups of fishes such as major carps, cat fishes, live fishes, feather backs, sheet fishes, eels etc. form the bulk of total production of this region.

The present work pertains to a group of air-breathing fishes, commonly available in fresh water bodies of the region namely *Clarias batrachus* (Linn.), *Heteropneustes fossilis* (Bl.) and species of *Channa*. These include *Channa punctatus* (Bl.), *Channa striatus* (Bl.) and *Channa marulius* (Ham.). Out of the five species of *Channa* available in Madhya Pradesh, *Channa gachua* (Ham.), *Channa marulius* (Ham.)

Channa punctatus (Bl.), Channa striatus (Bl.) and Channa leucopunctatus (Bl.), only the above mentioned three species are available in the water dams. These fishes are predatory in nature. Since these fishes remain alive for a long period out of water, so they are usually marketed alive and also known as live fishes. These fishes are easy to handle in laboratory. Though these fishes are mostly non-commercial, yet they have their own economic value and great demand due to their high protein, high iron and low fat contents compared to that in carps. Clarias batrachus (Linn.) and H. fossilis (Bl.) are considered to be highly nutritious and esteemed as food where as species of Channa are eaten mostly by poor classes.

Thus efforts have been made to concentrate the work on these host fishes and to obtain maximum number of parasites from them throughout the period of study.

In order to make the faunistic studies more elaborate and objective, host parasite relationship has also been studied and analysed statistically, in order to study index of total helminth infection; host-wise analysis; overall incidence; level and intensity of parasitization; seasonal incidence; and intensity of infection in trematodes. Such calculations can help considerably in the correct understanding of the nature and extent of their pathogenic role.

The present findings definitely contribute to the general survey of the parasitic fauna of this region. It may help the pisciculturists in understanding better the effect of parasitization on the fishes, thus helping to increase the production of fish as food to human beings.

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H I S T O R I C A L   R E S U M E

<u>HISTORICAL RESUME</u>

Helminth parasites have been known to mankind since Vedic and Post-Vedic period around 800 B.C.., as in <u>Atharvaveda</u> these worms are referred to as <u>Krimis</u>. Great medical treatises of Charak and Susruta (between 200 B.C. and 200 A.D.) even mentioned detailed treatment of parasites. A detailed account of knowledge of these worms in ancient India is given by Bhaduri, Tiwari and Biswas (1972).

Our present day knowledge of helminth parasites dates back to 1379, when Jehan - de - Brie (1379) who for the first time discovered fluke <u>Fasciola</u>. The first references to trematodes, probably <u>Fasciola jacksoni</u> and <u>Pseudodiscus hawkesi</u>, from Indian region in modern times is made by Gilchrist, who has worked on them in the years 1841-1846. Later on, Cobbold (1869-1882) wrote a series of papers describing parasites of elephont, cattle and Gangetic dolphin and thus making the begining of the scientific study of trematode fauna of India.

Bhalerao (1926) was the first Indian helminthologist to give a boost to Indian helminthology in general and study of trematodes in particular. He was followed by a band of dedicated workers like Mehra, Verma, Moghe, Thapar, Lal, Srivastava (H.D.), Chauhan, Pande and many others, who contributed much to our present day knowledge of the

trematodes from Indian region. Bhalerao (1939) reviewed the progress of the knowledge of trematodes in India till that time. In 1956,Thapar and Chauhan in 1963 also discussed the progress of helinthology in India with special reference to trematodes. Some of the more important contributions in this field include -

Bhalerao (1926, 36); Verma (1927, 36); Chauhan (1940, 49, 54, 55); Srivastava, H.D. (1938, 48); Mehra,H.R.(1935, 38, 62, 66); Pande (1937); Patwardhan (1935); Khan (1935); Mehra, R.K. (1941); Kaw (1950); Dayal (1948, 49, 50); Baugh (1949, 50); Gupta (1950, 51, 55, 56); Jaiswal (1957), Jain (1967) and Pandey, K.C. (1970).

Helminth parasites of Indian fishes have not received the attention they deserve, except for the systematics of certain parasites. A perusal of literature shows that following Indian workers have described the trematode parasites of fishes -

Billet (1899) described Isoparorchis hypselobagri from Wallagoattu and also immature forms of the some from Barbus tor, Channa striatus, Notopterus notopterus and Mastacembelus armatus from India.

Southwell (1913) described Isoparorchis trisimilitubis which was later renamed as I. hypselobagri from the air bladder of wallago attu.Verma (1927) reported Opisthorchis

pedicellata from the gall bladder of Rita rita. He (1935) also recorded gastorostones from siluroid fishes.

A large number of workers have made substantial contribution on the taxonomy of trematode parasites. These include :-

Southwell and Prashad (1918) described Clinostomum piscidum from Nandus nandus.

Verma (1927) described Opisthorchis pedicellata from Bagarius varrellii and Rita rita from Allahabad.

Thapar (1930) described Gomtia piscicola from Bagarius varrellii from Lucknow.

Srivastava, H.D. (1933) described Progonus piscicola and Progonus ovocaudata from Ophiocephalus punctatus; Ophiocorchis lobata and Ophiocorchis singularis from Ophiocephalus striatus from Allahabad.

Pande (1934) described Orientocreadium indicum from Heteropneustes fossilis and Rita buchanani from Allahabad. In (1937) he described Allocreadium handiai from Ophiocephalus punctatus. In (1938) he described Allocreadium kosia from Barbus Chilinoides; Allocreadium schizothoracis from Schizothorax micropogon; Allocreadium mahaseri from Barbus tor from Allahabad.

Dayal (1949) described Phyllodistomus vachius from Eutropiichthys vacha from Lucknow and Allahabad.

Bhalerao (1941) described Clinostomum indicum from Notopterus notopterus from Allahabad. In (1942) he described Clinostomum dasi from Saccobranchus fossilis and Clinostomum prashadi from an unidentified fish from Hyderabad.

Mehra (1941) described Opisthorchis pedicellata minutus from Mystus seenghala and Wallago attu from Allahabad.

Gupta (1950) described Allocreadium thapari from Rita rita from Hardoi. In (1951) he described Phyllodistomum singhiai from Mastacembelus armatus from Lucknow and Saharanpur. In (1953) he described Haplorchoides seenghali from Macrones seenghala; Phyllodistomum vittatusi from Macrones vittatus; Haplorchoides ritai, Haplorchoides brahamputraensis from Rita rita from Assam; Haplorchoides gomtioensis from Silundia gangetica from Lucknow. In (1956) he described Allocreadium kamali from Chela bacaila, Allocreadium mehrai from Rhychobdella aculeata from Lucknow. In (1963)he described Allocreadium makundai from Barbus sarana from Banaras.

Gupta and Verma (1976 Publ. 1977) described Allocreadium mrigali, Allocreadium baranai, Allocreadium saranai from Cirrhina mrigala, Barilius barana and Barbus sarana respectively.

Kaw (1950) described Allocreadium nemacheilus from Nemacheilus kashmirensis; Clinostomum schizothoroxi from Oreinus sinatus, Schizothorax micropogon; Phyllodistomum loossi from Schizothorax socinus from Kashmir.

Jaiswal (1957) described Phyllodistomum (Catroptoides) indianum from Heteropneustes fossilis and Phyllodistomum Parorchium from Glossogobius (Gobius) giuris; Euclinostomum chanai from Ophiocephalus punctatus; Clinostomum macrosomium from Mastacembelus armatus from Hyderabad.

Saksena (1958) described Orientocreadium raipurensis, Orientocreadium dayali from Clarias batrachus; Allocreadium spindala from Mastacembelus armatus from Raipur. In (1960) he described Orientocreadium umadasi from Clarias batrachus from Raipur.

Srivastava, P.S. (1960) described Allocreadium ophiocephali from Ophiocephalus punctatus from Raipur.

Motwani and Srivastava (1961) described Phyllodistomum chauhani from Mystus tor and Mystus seenghala; Phyllodistomum tripathi from Bagarius bagarius from India.

Rai (1962) described Allocreadium dollfusi, Allocreadium singhi, Allocreadium hirnai from Barbus tor from the River Hiran, near Katangi and Sehora (M.P.).

Srivastava, C.B. (1962) described Pycnadena komiyai from Oxygaster gora from India.

Agrawal (1964) described Allocreadium heteropneustusius from Heteropneustes fossilis; Haplorchoides macroni from Macrones seenghala from Lucknow. In (1966) she described Genarchopsis punctati from Ophiocephalus punctatus from Lucknow.

Kakaji (1969) described Genarchopsis cameroni from Mystus seenghala; Allocreadium catlai from Catla catla; Genarchopsis cuchiai from Amphipnous cuchia from Lucknow. In the same year, she described Allocreadium guptai and Allocreadium fasciatusi from Rita rita and Trichogaster fasciatus, respectively from Varanasi.

Fotedar (1969) described Phyllodistomum megacotyle from Garra mullya from Kashmir.

Pande, B.P. and Shukla, R.P. (1976) described Haplorchoides pearsoni and Haplorchoides mehrai from Channa punctatus and Mystus vittatus, respectively from Lucknow.

Gupta, V. and Puri, M. (1979, Publ. 1980) described Allocreadium calbassii, Allocreadium manteri from Labeo calbasu, Anabas testudineus, respectively from Lucknow.

Systematics of fish cestodes of India region have been studied by Hornell (1912); Southwell (1913, 1915, 1925, 1930); Moghe (1925); Woodland (1924); Subramanium (1939, 1940) and many other workers. Johri (1959) described new cestodes from fishes. Rao (1960) studied Mehlis gland complex by histochemical methods and also described a new species of ptychobothrium from a flying fish. Agarwal (1965-1980) studied fish cestodes from Raipur. Rajyalaxmi (1981-1988) studied Cestodes of Waltair Coast fishes.

In Madhya Pradesh also, lot of work was done at Jabalpur, Raipur, Rewa, Ujjain and Gwalior by Singh, Agarwal, Dwivedi, Rai, Saxena, Jain, Khoche, Johri, Dandotia and others. However little work has been done on the helminth parasites of fishes of Bundelkhand region.

From the foregoing account, it is evident that considerable progress is being made in the knowledge of helminth fauna and its taxonomic study of this country, but very little work has been done to ascertain the incidence of parasites and estimation of helminthic infection. The important contributions in this field have been made by Srivastava, C.B. and Mukherjee, G.D. 1986; Siddiqui A.H.; Nizami, W.A. (1988) Devraj, M & Ranganathan, V (1991); Bahaduria, S. (1982), Dandotia, M.R. (1984, 1992, 1994) and others. Still a wide lacuna is left in this field considering the richness of fauna of parasite helminthes.

MATERIAL AND METHOD

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The host fishes were collected from several dams, ponds and other local fresh water bodies in and around Jhansi and in the Bundelkhand region. Fishes were also purchased from local fish markets of Sipri and Raiganj Bazar.

These host fishes were kept alive in aquaria in the laboratory and then freshly killed, dissected and examined at convenience. A thorough search was done to determine the where-abouts of parasites. Various organs particularly body cavity, stomach, duodenum, intestine, rectum, gall bladder and Kidneys were carefully examined in petridish under low power binocular.

Soon after collection, the trematodes were thoroughly washed and kept in saline water. They were studied alive and observations were made regarding the colour and movements of body, spines on the body, oral and ventral suckers, cirrus and metraterm, excretory bladder and its branches.

For fixation 5-10% formaline was used. For whole mounts, preservation in formaline for longer periods gave good results. For preparing whole mounts, precaution was taken to avoid over or under pressure.

For preparing whole mount of trematodes, after fixation and thorough washing in water, worms were dehydrated and stained in Borox Carmine, then cleared in xylene and finally mounted in DPX. The drawings of the whole mounts were made with the help of camera lucida at a suitable magnification.

To record the seasonal incidence, the fishes were examined at regular intervals from July 1993 to June 1995. In all, 75 fishes per month with an average of 15 fishes per month of each species were examined. A total of 1800 fishes were collected and studied during two years period. The data collected was studied and statistically analysed. Thus index of total helminth infection (Trematodes), host-wise analysis, overall incidence, level and intensity of parasitization, seasonal incidence.

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A SYSTEMATIC LIST OF THE HOSTS EXAMINED

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Class	Teleostomi
Subclass	Actinopterygii
Order	Cypriniformes
Division	Siluri
Sub-order	Siluroidei
Family	Clariidae
Example	*Clarias batrachus* (Linn.)
Family	Saccobranchidae
Example	*Heteropneustes fossilis* (Bl.)
Order	Ophiocephaliformes
Family	Ophiocephalidae
Example	*Channa punctatus* (Bl.)
Example	*Channa striatus* (Bl.)
Example	*Channa marulius* (Ham.)

HOST - PARASITE LIST

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Selected fresh water fishes have been examined for the present study of helminth parasites. These fishes are - Clarias batrachus (Linn.), Heteropneustes fossilis (Bl.) and sp. of Channa - namely : Channa punctatus (Bl.) Channa striatus (Bl.) and Channa marulius (Ham.) which are available locally and in Bundelkhand region in plenty. These live fishes were examined thoroughly for helminth infection and parasites were collected.

The following host - parasite list includes only the forms collected by the author and described in the present thesis. This includes species of digenetic trematodes only. Majority of the parasites form first host and locality record from this region and a new species recovered from Clarias batrachus and Heteropneustes fossilis.

Host - Parasite list

Name of the host	Name of the parasite
Channa punctatus (Bl.)	Genarchopsis singularis Srivastava, 1933.
	Genarchopsis goppo Srivastava, 1933
	Genarchopsis piscicola Srivastava, 1933.

	Orientocreadium indicum Pande, 1934.
	Allocreadium handiai Pande, 1937.
	Metacercaria
	Euclinostomum heterostomum (Rudolphi,1809) Travassos,1928.
	Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911.
	Clinostomum complanadum (Rudolphi,1819) Braun, 1899.
Channa striatus (Bl.)	*Genarchopsis singularis* Srivastava, 1933.
	Orientocreadium indicum Pande, 1934.
	Allocreadium handiai Pande, 1937.
	Metacercaria
	Isoparorchis hypselobagri (Billet,1898) Odhner, 1911.
Channa marulius (Ham.)	*Orientocreadium indicum* Pande, 1934
	Metacercaria

	Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911.
Heteropneustes fossilis (Bl.)	*Orientocreadium indicum* Pande, 1934.
	Orientocreadium pseudobagri Yamaguti, 1934.
	Orientocreadium keni n.sp.
	Allocreadium handiai Pande, 1937
	Haplorchoides seenghali Dayal and Gupta, 1954.
	Phyllodistomum tripathi Motwani and Srivastava, 1961.
Clarias batrachus (Linn.)	*Orientocreadium indicum* Pande, 1934
	Orientocreadium Pseudobagri Yamaguti, 1934.
	Orientocreadium keni n.sp.
	Orientocreadium batrachoides Tubangui, 1931.

Allocreadium handiai

Pande, 1937.

Pycnadena bariliusi

V. Kumari, 1973.

PARASITE - HOST LIST

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Parasite	Host	Location
Pycnadena bariliusi V. Kumari, 1973.	*Clarias batrachus* (Linn.)	Stomach
Allocreadium handiai Pande, 1937.	*Clarias batrachus* (Linn.)	Intestine
	Heteropneustes fossilis (Bl.)	Intestine
	Channa punctatus (Bl.)	Intestine
	Channa striatus (Bl.)	Intestine
Orientocreadium batrachoides Tubangui, 1931.	*Clarias batrachus* (Linn.)	Intestine
Orientocreadium indicum Pande, 1934	*Clarias batrachus* (Linn.)	Intestine
	Heteropneustes fossilis (Bl.)	Intestine
	Channa punctatus (Bl.)	Intestine
	Channa striatus (Bl.)	Intestine
	Channa marulius (Ham.)	Intestine
Orientocreadium pseudobagri Yamaguti, 1934.	*Clarias batrachus* (Linn.)	Intestine

Parasite	Host	Location
Orientocreadium keni n.sp.	Clarias batrachus (Linn.)	Intestine
	Heteropneustes fossilis (Bl.)	Intestine
Phyllodistomum tripathi Motwani and Srivastava, 1961.	Heteropneustes fossilis (Bl.)	Intestine
Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911	Channa punctatus (Bl.)	Body cavity
	Channa striatus (Bl.)	Body cavity
	Channa marulius (Bl.)	Body cavity
Genarchopsis piscicola Srivastava, 1933.	Channa punctatus (Bl.)	Intestine
Genarchopsis goppo Srivastava, 1933.	Channa punctatus (Bl.)	Intestine
Genarchopsis singularis Srivastava, 1933	Channa punctatus (Bl.)	Intestine
	Channa striatus (Bl.)	Intestine

Parasite	Host	Location
Euclinostomum heterostomum (Rudolphi, 1809) Travassos, 1928.	Channa punctatus (Bl.)	Body cavity
Clinostomum complanatum (Rudolphi, 1819) Braun, 1899.	Channa punctatus (Bl.)	Body cavity
Haplorchoides seenghali Dayal and Gupta, 1954.	Heteropneustes fossilis (Bl.)	Intestine

PART - II

Ovary pretesticular and intertesticular, submedian, diagonally oval, measures 0.17 x 0.010. Receptaculum seminis large. Uterus very extensive, ascending and descending coils extend from pharynx to posterior end of the body. Eggs numerous, oval, yellow, small. Vitelline follicles lateral, extending from oral sucker to posterior end of the body, confluent in posttesticular region.

Discussion

Linton (1911) proposed the name *pycnadena* to replace the generic name *Didymorchis* erected by him in 1910, since it was preoccupied. Srivastava, C.B. (1962) described *Pycnadena komiyai* and placed it under the family *Allocreadiidae* following Yamaguti (1958), Manter (1947), Skrjabin and Koval (1957) placed it under the family Fellodistomidae. In the present study latter arrangement is accepted.

This species resumbles *P. africana* Fischthal and William (1971) in the shape of the body and in having longer hindbody and posttesticular space but differs from it in the absence of post-oral ring, in the shape and size of cirrus sac, which is small instead of long and retort-shaped, position of genital pore, which is on the anterior margin of acetabulum instead of posterior part of pharynx, size of the testes, which are much smaller than ovary,

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1.	Post-oral muscular ring present	2
	Post-oral muscular ring absent	4
2.	Body-broad, oval, nearly as broad as long or breadth equal to 3/4 length, gonads situated near posterior extremity.	3
	Body oval, hind body larger, gonads in anterior half of hind body	P. africans
3.	Cirrus pouch short, lying at the anterior border of acetabulum, genital pore median at the base of pharynx, vitellaria diffused extending from pharynx to hind end of the body	P. lata
	Cirrus pouch long, slender, genital pore submedian, near left margin of body, at level of anterior margin of pharynx, vitellaria very limited extending from anterior margin of acetabulum to ends of intestinal caeca	P. pyriformae
4.	Testes symmetrical, uterus extending up to posterior end of the body, eggs with occulated embryos	P. bariliusi
	Testes tandem, uterus extending up to testes, eggs not embryonated parasites of fresh water fishes	P, komiyai

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Testes obliquely tandem, median, spherical or oval, postacetabular, intercaecal. Anterior testis smaller than posterior testis and measures 0.03 - 0.24 x 0.05 - 0.24. Posterior testis measures 0.078 - 0.25 x 0.05 - 0.24. Cirrus sac oval to club shaped, situated in between intestinal bifurcation and acetabulum, measures 0.08 - 0.18 x 0.03 - 0.11. Vesicula seminalis bipartite.

Ovary small, oval, submedian or median, attached to acetabulum, measures, 0.05 - 0.17 x 0.04 - 0.10. Receptaculum seminis and laurer's canal present. Shellgland complex large, uterus pretesticular. Vitellaria consists of large number of follicles extending from posterior margin of acetabulum and reaching almost upto hind end of the body and almost confluent in posttesticular region.

Excretory bladder tubular extending upto posterior border of posterior testis. Eggs large, yellow, oval embryonated, filamented and measures 0.07 - 0.10 x 0.03 - 0.05.

Discussion

This species has been described by Pande (1937) from the intestine of Channa punctatus from Handia, Allahabad and Haldwani. Kaw (1950) recorded this species from some other vertebrates, Coil and Kuntz, 1960 described it from small intestine of Channa punctatus from Dacca (Bangla Desh).

Testes obliquely tandem, median, spherical or oval, postacetabular, intercaecal. Anterior testis smaller than posterior testis and measures 0.03 - 0.24 x 0.05 - 0.24. Posterior testis measures 0.078 - 0.25 x 0.05 - 0.24. Cirrus sac oval to club shaped, situated in between intestinal bifurcation and acetabulum, measures 0.08 - 0.18 x 0.03 - 0.11. Vesicula seminalis bipartite.

Ovary small, oval, submedian or median, attached to acetabulum, measures, 0.05 - 0.17 x 0.04 - 0.10. Receptaculum seminis and laurer's canal present. Shellgland complex large, uterus pretesticular. Vitellaria consists of large number of follicles extending from posterior margin of acetabulum and reaching almost upto hind end of the body and almost confluent in posttesticular region.

Excretory bladder tubular extending upto posterior border of posterior testis. Eggs large, yellow, oval embryonated, filamented and measures 0.07 - 0.10 x 0.03 - 0.05.

Discussion

This species has been described by Pande (1937) from the intestine of Channa punctatus from Handia, Allahabad and Haldwani. Kaw (1950) recorded this species from some other vertebrates, Coil and Kuntz, 1960 described it from small intestine of Channa punctatus from Dacca (Bangla Desh).

Host	:	*Clarias batrachus* (Linn.)
		Heteropneustes fossilis (Bl.)
		Channa striatus (Bl.)
		Channa punctatus (Bl.)
Location	:	Intestine
Locality	:	Lalitpur, (U.P)

Family : ALLOCREADIIDAE Stossich, 1903

Sub family : ORIENTOCREADIINAE Yamaguti, 1958

Genus : Orientocreadium Tubangui, 1931

Orientocreadium batrachoides Tubanqui, 1931
(Fig. 3)

Two samples of Orientocreadium batrachoides were collected from the intestine of Clarias batrachus (Linn.) during the two year study period from a pond at Moth in District Jhansi.

Description

The body is spinose, elongated, spindle shaped, with rounded anterior and blunt posterior end, measures 1.586 x 0.32. The maximum breadth is at the level of anterior testis. Oral sucker is subterminal, rounded and measures 0.14 x 0.15. Acetabulum is submedian, rounded and measures 0.14 x 0.15 roughly equal to the oral sucker. Prepharynx is large, measures 0.017 x 0.045. Pharynx is well developed, measures 0.078 x 0.082. Oesophagus is very small. Intestinal caecae are simple, long, terminating at posterior extremity.

The testes are rounded, entire, sub-equal, tandem, postequatorial, measuring 0.13 - 0.15 x 0.28 - 0.25. Cirrus sac is long, curved, lying lateral to acetabulum and

extends well behind it. It contains a vesicula seminalis interna, pars-prostatica and cirrus. Vesicula seminalis externa is long, saccular. Male and female genital opening are separate, preacetabular and median.

Ovary is oval, pretesticular, equatorial, intercaecal, lying between acetabulum and anterior testis and measures 0.12 x 0.26. Receptaculum seminis is present. Vitelline follicles extend from the level of ovary upto hind end of the body. In posttesticular region, the follicles oftwo sides merge together. Eggs numerous, oval and measures 0.018 x 0.011.

Excretory bladder is tubular with terminal excretory pore.

Discussion

The genus Orientocreadium was established by Tubangui, in 1931 to include Orientocreadium batrachoides, parasitic in Clarias batrachus (Linn.). In 1934, Yamaguti added Orientocreadium indicum from Rita buchanani and Orientocreadium pseudobagri from Pseudobagrus aurantiacus. He considered the genera Ganada Chatterji, 1933; Neoganada Dayal, 1938 and Nizamia Dayal, 1938 as synonymous with the genus Orientocreadium and also transferred their species under it.

The type species *Orientocreadium batrachoides* Tubangui, has been described in detail by many workers with little variations. These include Beverley-Burton, (1962) from *Clarias mossambicus* and *Clarias mellandia*; Fischthal and Kuntz, 1963; Kakaji, 1969 from *Rita rita*; Pandey, 1971 from *Ophiocephalus punctatus* and Jain and Chandra (1977) from *Channa punctatus*.

Yamaguti (1958) has described twelve species under the genus *Orientocreadium*. *Orientocreadium ottoi* has been considered a synonym of *O. batrachoides* Tubangui (1931).

This species has not been described from this locality, it is recorded herein.

Host	:	*Clarias batrachus* (Linn.)
Location	:	Intestine
Locality	:	Moth, District Jhansi, (U.P).

Family : ALLOCREADIIDAE Stossich, 1903

Sub family : ORIENTOCREADIINAE Yamaguti, 1958

Genus : *Orientocreadium* Tubangui, 1931

Orientocreadium indicum Pande, 1934
(Fig. 4)

The author collected 127 specimens of a trematode belonging to the genus *Orientocreadium* Tubangui, 1931 from the intestine of *Clarias batrachus* (Linn.). In all 360 specimens of the said host were examined of which 21 were found infected. This parasite was also recovered from the intestine of *Heteropneustes fossilis* (Bl.) 360 specimens of this host were examined of which three were found infected and seven specimens were collected. All the three species of *Channa* - namely *Channa punctatus* (Bl.) *Channa striatus* (Bl.) and *Channa marulius* (Ham.) available locally were found heavily infected with this trematode. Thus out of 360 specimens of *Channa punctatus* examined, ten treamatodes of this species were collected from three specimens. Out of 360 specimens of *Channa striatus* examined, three fishes were found infected and six trematodes were collected; out of 360 specimens of *Channa marulius* one was found infected with three specimens of this parasite.

On subsequent study it appears to be Orientocreadium indicum Pande, 1934 and has been described as such.

Description

Body small, elongated, spinose with rounded anterior and bluntly tapering posterior extremities, measuring 1.2 - 2.5 x 0.24 - 0.34, maximum width being in preequatorial region. Oral sucker spherical, subterminal, 0.08 - 0.13 x 0.10 - 0.13. Well developed prepharynx is present, 0.05 - 0.09 in length, followed by muscular pharynx 0.08 - 0.10 x 0.09 - 0.11. Oesophagus very small. Intestinal caecae long, reaching upto posterior end. Acetabulum spherical, preequatorial, almost equal to oral sucker, measuring 0.13 - 0.19.

Testes median, postequatorial with entire margin, measures 0.14 - 0.19 x 0.09 x 0.09 - 0.14 and 0.15 - 0.21 x 0.09 - 0.14 respectively. Cirrus Sac large, spined, crescent shaped to the right of acetabulum,0.24 - 0.32 in length, enclosing pear shaped vesicula seminalis, pars prostatica, ejaculatory duct and protrucible cirrus. Vesicula seminalis externa in between ovary and acetabulum is present. Genital pore submedian, preacetabular.

Ovary median or submedian, postequatorial, situated midway between acetabulum and anterior testis, spherical,

0.09 - 0.12 x 0.06 - 0.10. Receptaculum seminis is absent, laurer's canal is present. Uterus extensive, occupying the whole postacetabular space, terminating in metraterm, opening in genital atrium. Vitellaria extend from the anterior border of ovary to posterior end of the body, where the follicles of the two sides meet. Eggs numerous, oval, operculate, yellow, 0.030 - 0.36 x 0.010 - 0.017.

Excretory bladder extending upto posterior margin of testes, excretory pore terminal.

Discussion

Pande (1934) described this new species *Orientocreadium indicum* from the intestine of *Rita buchanani* from river Gomati at Jaunpur, Uttar Pradesh. This species differed from type species *O. batrachoides* Tubanqui, 1931 by the presence of spined cirrus and metraterm, spherical ovary instead of oval, maximum width in preequatorial region, vitellaria extending from posterior margin of acetabulum to posterior end of body where the follicles of two sides meet without forming lattice.

Yamaguti (1954, 1958), Saksena (1958, 1960), Gupta (1961) and Khalil (1961) accepted it as a valid species. Fischthal and Kuntz (1963) also accepted *O. indicum* as a valid species, characterised by the presence of spined

cirrus and metraterm, characters lacking in O.batrachoides and completely overlooked by Beverley-Burtan. Thus O.indicum is a valid species.

The present material forms new host and locality record. For the first time the specimen has been recorded from a number of air-breathing fishes like Clarias batrachus (Linn.), Heteropneustes fossilis (Bl.), Channa punctatus (Bl.) Channa striatus (Bl.) and Channa marulius (Ham.).

Host	:	Clarias batrachus (Linn.)
	:	Heteropneustes fossilis (Bl.)
	:	Channa punctatus (Bl.)
	:	Channa striatus (Bl.)
	:	Channa marulius (Ham.)
Location	:	Intestine
Locality	:	Jhansi, (U.P.)

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Family : ALLOCRADIIDAE Stossich, 1903

Sub family : ORIENTOCREADIINAE Yamaguti, 1958

Genus : Orientocreadium Tubangui, 1931

Orientocreadium pseudobagri Yamaguti, 1934

(Fig. 5)

The author collected 17 specimens of a trematode belonging to the genus Orientocreadium Tubangui, 1931 from the intestine of Clarias batrachus (Linn-). In all 360 specimens of the said host were procured from the river Betwa in District Hamirpur and examined, of which eight were found infected. This parasite was also recovered from the intestine of Heteropneustes fossilis (Bl.) 360 specimens of this host were examined of which two were found infected and four parasites were collected this parasite was also recovered from the intestine of Channa punctatus (Bl.) 360 specimens of this host were examined of which three were found infected and four trematodes were collected.

Description

Body spindle shaped, spinose with rounded anterior end and bluntly tapering posterior extremity, measures 2.8 - 3.10 x 0.53 - 0.55. Oral sucker is simple, subterminal oval, 0.12 - 0.14 x 0.14 - 0.17. Prepharynx is short. Pharynx comparatively large, oval, 0.038 - 0.09 x 0.13 - 0.14, Oesophagus long, measures 0.33 - 0.39. Intestinal

caecae long and reach nearly upto posterior extremity of body. Acetabulum spherical, preequatorial, 0.16 - 0.18.

Testes postequatorial, entire, oval or spherical, subequal or equal, tandem and measuring 0.17 - 0.20 x 0.19 - 0.21 and 0.18 - 0.21 x 0.18 - 0.20. The vesicula seminalis externa and vesicula seminalis interna are present. Vesicula seminalis externa occupies expanded basal part of the cirrus pouch and is elongated and oval in shape; vesicula seminalis interna is short, retort shaped, lies infront of ovary. The cirrus pouch is crecsent shaped, running close to acetabulum on its right side, opening into genital atrium. Genital pore is preacetabular submedian and postbifurcal.

Ovary is pretesticular, round to oval, median, lies between acetabulum and anterior testis and measures 0.16 - 0.17. Shellgland complex behind the ovary. Uterus extends upto hind end of the body. Eggs numerous, oval, yellow, 0.020 - 0.026 x 0.005 - 0.008. Vitelline follicles extend from the mid acetabular region upto the hind end of body beyond the posttesticular region.

Excretory bladder is wide with terminal excretory pore.

Discussion

Tubangui (1931) created the genus Orientocreadium

and placed it under the family Allocreadiidae and later (1933) under the subfamily Allocreadiinae. McMullen (1937) erected the family Macroderoidae. Which was accepted by La Rue (1957) and Mehra (1966).

Yamaguti (1958) created the subfamily Orientocreadiinae to include the genera *Orientocreadium* and *Macrotrema* under the family *Allocreadiidae*. In the present work the family Allocreadiidae has been accepted.

Yamaguti (1958) has described 12 species under the genus *Orientocreadium*. The present specimens compare well with *Orientocreadium pseudobagri* Yamaguti, 1934, except some minor individual variations like oval oral sucker, small prepharynx, long oesophagus and extension of vitellaria halfway between thecaudal testis and posterior tip of the body and cirrus pouch on the right side of acetabulum instead of overlapping it. These variations may be considered as individual variations, so the pfesent specimens are referred to as *O. pseudobagri* Yamaguti, 1934.

This is the first new locality record of this species.

Host	:	*Channa punctatus* (Bl.)
	:	*Heteropneustes fossilis* (Bl.)
	:	*Clarias batrachus* (Linn.)
Location	:	Intestine
Locality	:	Hamirpur, (U.P.)

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Family	:	ALLOCREADIIDAE Stossich, 1903
Sub family	:	ORIENTOCREADIINAE Yamaguti, 1958
Genus	:	Orientocreadium Tubangui, 1931.

Orientocreadium keni n.sp.

(Fig. 6)

Fifteen worms of this species were collected from the intestine of Clarias batrachus (Linn.) and Heteropnoustes fossilis (Bl.) from the river Ken, in District Banda (U.P).

Description

Body spinose, small, elongated, measures 1.6 - 1.9 x 0.27 - 0.37. Maximum width being in pre-equatorial region. Oral sucker sub-terminal, rounded, 0.10 - 0.13 x 0.12 - 0.13. Prepharynx present, measures 0.02 - 0.05 in length. Pharynx spherical, muscular, measures 0.09 - 0.11 x 0.010 - 0.12. Oesophagus very small or absent. Intestinal caecae terminate at posterior extremity. Acetabulum spherical, pre-equatorial, 0.14 - 0.18.

Testes sub-median, transversly elongated, tandem, postequatorial, oval with entire margin, measures 0.12 - 0.17 x 0.07 - 0.12 and 0.13 - 0.19 x 0.07 - 0.12 respectively. Cirrus sac large, crescent shaped, 0.22 - 0.33 in length, situated to the right of the acetabulum, enclosing pear shaped vesicula seminalis, well developed pars prostatica, long, spined ejaculatory duct and protrucible cirrus. Well

developed coiled vesicula seminalis externa situated in between acetabulum and ovary. Genital pore preacetabular, submedian.

Ovary median, postequatorial, transversly elongated, situated midway between acetabulum and anterior testis, oval, 0.08 - 0.11 x 0.06 - 0.09. Shellgland complex posterolateral to ovary. Receptaculum seminis absent. The Laurer's canal present. Uterus very extensive, occupying the whole postacetabular space with descending and ascending coils. Vitellaria consists of large number of follicles, extending from posterior border of acetabulum to posterior end of the body. Eggs numerous, yellow, oval, operculated, 0.023 - 0.034 x 0.011 - 0.016 m.m. in size.

Discussion

The present species combined the characters of Orientocreadium indicum as well as O. pseudobagri but has its own distinctive features. It differs from both inhaving small body, transversly elongated ovary and testes, very small oesophagus, eggs rounded or oval.

Thus the present form differs from all other species it is therefore regarded as a new species and thus a new form Orientocreadium srivastavi has been added by the author in the present work.

This new form has been named after the name of the river Ken, from where these worms were recovered.

Host : *Clarias batrachus* (Linn.)

: *Heteropneustes fossilis* (Bl.)

Location : Intestine

Locality : Banda, (U.P).

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Family : GORGODERIDAE Loss, 1901

Sub family : PHYLLODISTOMINAE Yamaguti, 1958

Genus : Phyllodistomum Braun, 1899

Phyllodistomum tripathi Motwani & Srivastava, 1961
(Fig. 7)

Twelve specimens of Phyllodistomum tripathi Motwani and Srivastava, 1961 were collected from the intestine of Heteropneustes fossilis (Bl.) during the two year study period from Barwa dam, in District Banda (U.P).

Description

The body is aspinose, flask shaped, divisible into a narrow, tubular fore body and a foliate hind body with wavy margin and measures 1.63 x 2.31 mm in length and maximum width 0.75 x 1.21 mm just behind the posterior margin of acetabulum. Oral sucker is terminal, rounded, measures 0.208 - 0.320 x 0.210 - 0.318 in size. Acetabulum is larger than oral sucker, intercaecal, circular and measures 0.298 - 0.380 x 0.242 - 0.380 in size. Prepharynx and pharynx are absent. Mouth directly leads into oesophagus. Oesophagus is tubular, measures 0.149 - 0.715 in length and bifurcates into two simple, unbranched intestinal caeca, which extend upto hind region of body.

The testes are two in number, deeply lobed, intercaecal, postequatorial, obliquely tandem, placed in the expanded part of the body. They are more or less equal and measures 0.216 x 0.242 in size. Cirrus Sac is absent. Seminal vesicle is saccular, postbifurcal, intercaecal and anterior to acetabulum. Testes are separated by uterine coils.

The ovary is pretesticular, postacetabular, intercaecal, lobed, overlaps the right vitellaria and measures 0.098 - 0.210 x 0.136 - 0.325 in size. Receptaculum seminis is absent. Uterus with descending and ascending limbs, occupy intertesticular, posttesticular area, interlimbs, occupy intertesticular, posttesticular area, intercaecal and extracaecal. Its terminal part forms a muscular metraterm. The genital pore is situated behind the intestinal bifurcation, pre-acetabular, intercaecal, post bifurcal, preequatorial. The eggs are numerous, oval, operculated, both embryonated and unembryonated measures 0.014 - 0.016 mm in size.

Vitellaria consist of two lobed glands, lying behind the ventral sucker on each side of the body.

The excretory bladder is sigmoid with terminal excretory pore. Excretory pore is near posterior end of the body.

Discussion

Genus *Phyllodistomum* was erected by Braun (1899) with *Phyllodistomum folium* (Olfers, 1816) Braun, 1899 as the type. The parasites of this genus normally inhabit the urinary bladder and also the intestine of fishes. It is observed that the forms recorded from urinary bladder are invariably larger.

A total of 15 species (13 from fishes and 2 from amphibians) of the genus *Phyllodistomum* have been reported from India. A complete list has been given by Thomas (1958) and a key to Indian species by Gupta (1953). Rai (1971) has critically reviewed the Indian species of the genus *Phyllodistomum* and according to him the various species can be divided into three groups on the basis of relative size of oral sucker and acetabulum. The relative size of suckers oral and ventral is a specific character and is least variable in the species. Accordingly i.e. equal size of both suckers - *P. loossi* Kaw, 1950; acetabulum smaller than oral sucker - *P. vachius* Dayal, 1949; *P. vittatusi* Gupta, 1953; *P. chauhani* Motwani and Srivastava, 1969 and acetabulum larger than oral sucker - *P. simili* Nybelin, 1926; *P. lewisi* H.D. Srivastava, 1938; *P. singhiai* Gupta, 1951; *P. tripathi* Motwani and C.B. Srivastava, 1961 are described as valid species.

The present specimen in the collection of the author has acetabulum distinctly larger than oral sucker, *P. simili* Nybelin, 1926; *P. tripathi* Motwani and Srivastava 1961; *P. folium* Braun, 1899 exhibit this relative structure of suckers. The authors are in agreement with Kakaji, 1969 in considering *P. tripathi* Motwani and Srivastava, 1961 as a synonym of *P. folium* , as the presence or absence of notch on the posterior end of the body and relative size of various organs except the suckers are variable characters.

To the best of my knowledge the present form in the collection of author is *Phyllodistomum tripathi* Motwani and Srivastava, 1961 with wavy margins having thick folds along the margins. These characters can be regarded as variable characters.

Host	:	*Heteropneustes fossilis* (Bl.)
Location	:	Intestine
Locality	:	Banda (U.P.).

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Family : ISOPARORCHIIDAE Poche, 1926

Genus : *Isoparorchis* Southwell, 1913
(Syn. *Leptolecithum* Kobayashi, 1915)

Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911
(Fig. 8)

Metacercariae of this species were collected from the body cavity of *Channa punctatus* (Bl.), *Channa striatus* (Bl.) and *Channa marulius* (Ham.) during the months of April, January and September from the river Ken, in District Banda (U.P.).

Description

Body large, cylindrical, unspined with thick cuticle, flesh coloured, transluscent when expanded, foliate with bluntly projected anterior and broadly rounded posterior extremity and measures 1.02-4.05 x 0.62-1.07. Oral sucker is subterminal, oval, 0.16-0.39 x 0.17-0.49. Prepharynx absent, pharynx well developed. Oesophagus indistinguishable. Intestinal caeca long, serpentine, extending to near posterior end of the body. Acetabulum is larger than oral sucker, rounded, situated in the anterior half of the body and measures 0.27-1.09 x 0.27-1.2. Gonads indistinguishable. Genital pore situated between the two suckers at a distance of 0.31-0.61.

Excretory vesicle Y-shaped, excretory pore terminal.

Discussion

Isoparorchis hypselobagri (Billet, 1898) has been described as the type species of the genus *Isoparorchis* Southwell, 1913. The metacercaria of this species has been recorded from a number of fresh water fishes like *Wallago attu* and *Barbus tor* as has been listed by Pandey (1970) and Srivastava (1972). Srivastava (1977) discussed its host, distribution and relationships.

The writer has collected this specimen from all the species of *Channa* available locally, viz. *Channa punctatus* (Bl.) *Channa striatus* (Bl.) and *Channa marulius* (Ham.). This is the first host and locality record of the larva from Banda.

Host	:	*Channa punctatus* (Bl.)
	:	*Channa striatus* (Bl.)
	:	*Channa marulius* (Ham.)
Location	:	Body cavity
Locality	:	Banda (U.P.)

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Family : HEMIURIDAE Luhe, 1901

Sub family : HALIPEGINAE Ejsmont, 1931

Genus : Genarchopsis Ozaki, 1925

(Syn. Progonus looss, 1899 preoccupied)

Genarchopsis piscicola Srivastava, 1933.

(Fig. 9)

The present study is based on eight specimens of this species collected from intestine of Channa punctatus (Bl.). 360 specimens of Channa punctatus (Bl.) were procured from Dongri dam and Khaprar dam, in District Jhansi and dissected, of which intestine of four fishes were found infected with Genarchopsis.

Description

The body is small, fusiform, aspinose, muscular and measures 1.26-2.62 x 0.47-0.89. The oral sucker is subterminal, cuplike and measures 0.32-0.40 x 0.32-0.50. Acetabulum is large, postequatorial, well developed, muscular, almost spherical, measuring 0.60-0.87 x 0.61-0.87. The prepharynx is absent. Pharynx present, small and measures 0.11-0.13 x 0.02-0.19. Oesophagus absent. Intestinal caecae long and sinuous, extending upto posterior margin of body where they unite.

Testes oval, postacetabular, slightly obliquely tandem, extracaecal and anterior testis measures 0.24-0.37 x 0.17-0.28 and posterior testis 0.24-0.37 x 0.17-0.33 respectively. The cirrus sac absent. Pars prostatica is tubular and convoluted. The ejaculatory duct is short and opens along with metraterm into a short hermaphroditic duct.

Ovary small, postacetabular, intercaecal, spherical, situated almost at the level of posterior testis and measuring 0.15-0.23 x 0.12-0.33. The uterine coils are intercaecal, extending posteriorly upto the hind border of the testes. The left vitelline follicles measure 0.12 - 0.33 x 0.9 - 0.42, while right follicles measure 0.18-0.52 x 0.07-0.28. The genital pore just below pharynx near the intestinal bifurcation.

Discussion

Looss (1899) erected the genus Progonus for Mulleri Levinsen, 1881. He (1902) renamed it as Genarches thinking the name Progonus as preoccupied by the insect genus Progona Berg, 1886. Führmann (1904, 1928), Odhner (1905) considered Progonus as valid. Ozaki (1925) proposed a new genus Genarchopsis to accommodate his new species G.goppo Srivastava, H.D. (1933) while accepting the name progonus valid, considered the genus Genarchopsis as synonym of the former. He also erected a new genus Ophiocorchis to accommodate his new species O. lobatum. Yamaguti (1958,

1971) considered the genera Progonus, Genarches, Ophiocorchis as congeniric with Genarchopsis, the former two being, in his opinion, preoccupied. This arrangement is more or less being followed by the subsequent workers. Rai (1971) made a detailed study of various Indian species related to the genus Ophiocorchis and Genarches and came to the conclusion that all Indian species are synonym of G. goppo Ozaki, 1925. He however, did not deal with the question of the validity of the genus Progonus. Srivastava, H.D. and Sahai (1978) tried to revalidate the genus Ophiocorchis. The genus Progonus is not preoccupied as generally believed. According to Article 56 of International Rules of Zoological Nomenclature, the genera Genarchopsis, and Ophiocorchis have therefore been related to the genus Progonus.

The trematode under discussion has been compared with the valid species of genus Genarchopsis Ozaki, 1925 namely G. ovacaudatum, G. piscicola and G. dasus. It differs from G. ovocaudatum in the length and maximum width of the body, size of ovary, ratio of suckers and extension of uterine coils. It also differed from G. dasus (Gupta, 1951) in the length and maximum width of body, length and width of oral sucker, ratio of suckers and measurement of versicula seminalis.

However, the worm approaches more closely to G. piscicola Srivastava, 1933 in the extension of uterine coils

and principal body measurement, except for the differences in the length of the body, the ratio of suckers and the nature of the uterine coils. These variations are minor ones and do not suggest the proposition of a new species and so the present worms are referred to as *Genarchopsis piscicola* Srivastava, 1933.

Host	:	*Channa punctatus* (Bl.)
Location	:	Intestine
Locality	:	Jhansi (U.P.).

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Family : HEMIURIDAE Luhe, 1901

Sub family : HALIPEGINAE Ejsmont, 1931

Genus : Genarchopsis Ozaki, 1925
(Syn. Progonus Looss, 1899
preoccupied).

Genarchopsis goppo Srivastava, 1933
(Fig. 10)

Out of 360 specimens of Channa punctatus (Bl.) examined, the intestine of one was found infected with two worms of genus Genarchopsis Ozaki, 1925. The fishes were procured from Gunta dam at Mau, in District Banda, (U.P).

Description

Body elliptical with both extremities rounded and measuring 3.6 - 4.89 x 1.07 - 1.9. Maximum breadth in acetabular zone. Oral sucker oval, subterminal, 0.32 - 0.36 x 0.39 - 0.44. Pharynx oval, 0.17 - 0.4 x 0.17 - 0.20. Acetabulum large, spherical, equatorial, 0.79 - 0.85 x 0.79 - 0.87.

Testes oval, postacetabular, almost at the same level right measuring 0.25 - 0.31 x 0.45 - 0.47 and left 0.35 - 0.36 x 0.44 - 0.45 respectively. The cirrus sac absent. Vesicula seminalis well developed, long, cylindrical, postbifurcal, lying free in parenchyma which continues

into oval, compact pars prostatica surrounded by prostate gland cells. Terminal part of pars prostatica joins with metraterm to form hermaphroditic duct. Genital pore submedian in level with pharynx.

Ovary oval, postesticular, 0.16 - 0.30 x 0.4 - 0.38 lying just below right testis. Shellgland complex, postovarian. Receptaculum seminis uterinum present. Metraterm well developed, muscular, receiving pars prostatica at its distal end. Eggs with filament on one side. Vitellaria two lobed glands partly overlapping the intestinal caeca, lying in hind part of body.

Excretory bladder Y-shaped with the arms anastomosing dorsal to oral sucker.

Discussion

Srivastava (1933) described the type species *Progonus lobata* (Srivastava, 1933) from the stomach of *Channa striatus* from Lucknow. Gupta (1951) described *Genarchopsis faruquis* from the intestine of *Mastacembelus armatus* which is considered as synonym of this species in the light of the variations observed. *G. malanosticus* Dwivedi, 1965 and *G. cuchiai* Kakji, 1969 are considered conspecific with *P. lobata* as the characters used by them to differentiate their new species fall within the limit of variations.

The present specimen, therefore, has been described as type species Genarchopsis goppo Srivastava, 1933. This is the first locality record of this specimen from Banda.

Host	:	Channa punctatus (Bl.)
Location	:	Intestine
Locality	:	Mau (District Banda, U.P.)

Family : HEMIURIDAE Luhe, 1901

Sub family : HALIPEGINAE Ejsmont, 1931

Genus : Genarchopsis Ozaki, 1925 (Syn. Progonus Looss, 1899 preoccupied).

Genarchopsis singularis Srivastava, 1933
(Fig. 11)

360 specimens of Channa punctatus (Bl.) and 360 specimens of Channa striatus (Bl.) were examined during present study. Out of these, four and one specimen were found infected respectively with Genarchopsis singularis Srivastava, 1933. In all ten worms were collected from the intestine of hosts. The fisheswere procured from Rajghat dam, in District Lalitpur (U.P.).

Description

Body small, oval, 0.98 - 3.32 x 0.49 - 0.86 with maximum breadth at acetabular zone. Oral sucker oval, subterminal, 0.13 - 0.33 x 0.19 - 0.37. Pharynx oval, 0.08 - 0.2 x 0.07 - 0.10. Oesophagus small.

Testes symmetrical, postacetabular, oval, overlapping intestinal caeca, measuring 0.11 - 0.21 x 0.09 - 0.13 and 0.11 - 0.20 x 0.08 - 0.17 respectively. Cirrus sac absent.

Ovary small, spherical, median, posttesticular, lying in the hind part of body, anterior to vitelline follicles, 0.067 - 0.22 x 0.087 - 0.16. Shellgland complex postovarian. Uterus with transverse coils extending posteriorly upto vitelline zone which continues anteriorly as metraterm and opens into pars prostatica. Eggs yellowish oval, 0.021 - 0.037 x 0.011 - 0.015 with a filament on one side. Vitellaria two, compact, oval glands one on either side in posterior most part of the body.

Excretory bladder Y-shapped with arms anastomosing dorsal to oral sucker.

Discussion

Chauhan, 1953 in the comprehensive work on the family Hemiuridae maintained the genera Progonus and Ophiocorchis synonym of Genarches and transferred their species under it. Yamaguti, 1958 synonymised the genus Ophiocorchis Srivastava, 1933 (Progonus Looss, 1899, Preoccupied; Genarches Looss, 1902 Preoccupied) with Genarchopsis Ozaki, 1925.

Srivastava (1933) described Ophiocorchis singularis from the intestine of Channa marulius at Allahabad. Gupta (1951) collected some specimens from Channa punctatus at Lucknow and Saharanpur, U.P. and referred them to as new species Ophiocorchis indicum. Chauhan (1954) remarked that

the differences enumerated by Gupta do not merit the establishment of a new species and the two species should be considered identical.

The present specimens have been collected from Channa punctatus and Channa striatus from Rajghat dam in District Lalipur (U.P) and combine the characters of both the species. Thus it is evident that O. indicum is conspecific with O. singularis as suspected by Chauhan (1954). The present collection, however forms a new locality record.

Host	:	Channa punctatus (Bl.)
	:	Channa striatus (Bl.)
Location	:	Intestine
Locality	:	Lalitpur, (U.P.)

Key to the species of the genus Progonus Looss, 1899 :-

1.	Oesophageal pouch present Vitellaria lobed or compact		2
	Oesophageal pouch absent, Vitellaria compact		4
2.	Cirrus pouch present	P. thapari	
	Cirrus pouch absent		3
3.	Vitelline glands distinctly lobed acetabulum equatorial or post-equatorial	P. lobata	
	Vitelline glands compact or crenulated	P. singularis	

4.	Vitellaria a little anterior to posterior extremity and uterus extending beyond vitellaria	*P.mulleri*
	Vitellaria near posterior extremity, Uterus extending upto vitellaria or still anterior to it	5
5.	Main mass of uterine loops anterior to acetabulum	*P.piscicola*
	Uterus equally anterior and posterior to acetabulum	6
6.	Uterus mostly intercaecal	*P. goppo*
	Uterus extending into extracaecal zone	*P.angullae*

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Family : CLINOSTOMIDAE Luhe, 1901

Genus : Clinostomum Leidy, 1856

Clinostomum complanatum (Rudolphi, 1819) Braun, 1899
(Metacercaria)

The author collected 40 specimens of Clinostomum complanatum (Rudolphi, 1819) Braun, 1899 throughout the year 1993 to 1995 from the body cavity of Channa punctatus (Bl.).

The parasite resembles with the description given by previous workers and hence no description and measurement have been recorded.

Host : Channa punctatus (Bl.)

Location : Body Cavity

Locality : Lalitpur (U.P.).

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Family : CLINOSTOMIDAE Luhe, 1901

Sub family : EUCLINOSTOMINAE Yamaguti, 1958

Genus : Euclinostomum Travassos, 1928

Euclinostomum heterostomum (Rudolphi, 1809)
Travassos, 1928
(Fig. 12)

Metacercaria (Larval trematodes) of this species were collected in cysts from Body cavity of Channa punctatus (Bl.). Out of 360 specimens of Channa punctatus (Bl.) examined during 1993 to 1995, three fishes were found infected with these larval forms in the month of July and January. The fishes were procured from Rajghat dam, in District Lalitpur (U.P).

Description

Body large, oval, unspined with rounded extremities measures 4.9 - 5.7 x 2.42 - 3.03 with collar like formation at anterior end. Oral sucker very small, oval, subterminal measures 0.3 - 0.44 x 0.3 - 0.36. Pharynx small, thick walled, measures 0.13 - 0.16 x 0.16 - 0.18, surrounded by loosely arranged parenchymal muscles extending from posterior border of oral sucker to the base of collar, roughly halfway between intestinal bifurcation and acetabulum. Larval eye-spots present on either side of Pharynx. Oeso-phagus absent. Intestinal caeca very thin upto posterior

border of acetabulum, after which lateral diverticulae start. Lateral diverticulae are single and branched terminally postero-lateral, extending upto lateral margins of the body their number being 11 on the left side and 12 on the right. Acetabulum very large, spherical, median, preequatorial, measuring 1.27-1.5 x 1.2-1.29 at a distance of 1.17-1.35 from anterior end.

Testes postequatorial, tandem, median, intercaecal. Anterior testis crescent shaped and posterior testis y or V shaped, measuring 0.33-0.34 x 0.77-0.79 and 0.54-0.55 x 0.54-0.58 respectively. Vas-efferentia of posterior testis running parallel to right caeca and joins with vas-efferentia of the anterior testis, then enters the cirrus sac as vas-deferens. Cirrus sac small, oval, in front of anterior testis, in between its arms, enclosing bipartite seminal vesicle, pars prostatica and cirrus. Genital pore median, at the level of anterior third of cirrus sac.

Ovary small, oval, submedian, intertesticular, intercaecal, measuring 0.12-0.17 x 0.12-0.2. Oviduct, short arising from posterior border of ovary. Shellgland complex large, diagonally placed on one side of ovary. Metraterm very short and opens into genital atrium. Vitelline follicles very small, immature, lateral extending from posterior margin of acetabulum upto posterior margin of

acetabulum upto posterior end of body and continuous in posttesticular region.

Discussion

Travassos (1928) created the genus *Euclinostomum* with *Euclinostomum heterostomum* as its type species; a generic diagnosis was not given. Yamaguti (1958) created the sub-family *Euclinostominae* with *Euclinostomum* as its only genus.

The species *E. heterostomum* was first described as *Distoma heterostomum* by Rudolphi (1809). The description was rather brief and general dealing with external features and was without an illustration. Braun (1900) presented the first detailed account of the morphology of adult *E. heterostomum* from herons, *Ardea purpurea*, *A. cinerea* and *Nycticorax griseus*. Monning (1926) reported three metacercaria of *E. heterostomum* from the muscles of an unnamed fish. Joyeux and Houdemer (1928) recorded adult *E. heterostomum* from egrets, *Garzetta garzetta*. Metacercaria were found by them in the muscles of the fish, *Anabas scandens*.

Srivastava (1950) found metacercaria of *E. heterostomum* from *Channa punctatus* embeded in the liver and attached to the kidneys or muscles of the coelomic wall.

Adult worms occured naturally in the night heron, Nycticorax nycticorax.

Euclinostomum indicum was described by Bhalerao (1942) from the body cavity of Channa punctatus. Agrawal (1959) collected adult of E. indicum from herons, Bubulcus ibis fed with the fish, Channa punctatus, Fischthal and Kuntz (1963) considered E.indicum (Bhalerao, 1942, metacercaria; Agrawal, 1959 adult) synonym of E.heterostomum.

About a dozon species have been described so far under the genus Euclinostomum, of which five are from our country viz. E. heterostomum, E.bhagvantami, E.Channai, E.hepatocaecum and E. indicum. The characters utilized by previous workers for differentiating the known species of Euclinostomum are all highly variable and which include, the body shape, the structure of prepharynx, pharynx, oesophagus, number and shape of caecal diverticula. Perusal of literature shows that E. heterostomum the type species the genus, enjoys a wide host range and occurs in different geographical locality throughout the world. Its metacercarias are found in fresh water fishes consequently wide morphological variations in the anatomy are natural in this species.

The present specimens agree with the description given by the Braun (1900) except in the presence of well developed pharynx and vitellaria, which are considered as individual variations of *E. heterostomum*.

Host	:	*Channa punctatus* (Bl.)
Location	:	Body cavity
Locality	:	Lalitpur, (U.P.)

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Family : HETEROPHYIDAE Odhner, 1914

Sub family : HAPLORCHIINAE Looss, 1899

Genus : *Haplorchoides* Chen, 1949

Haplorchoides seenghali Dayal and Gupta, 1954
(Fig. 13)

One specimen of this species was collected from the intestine of *Heteropneustes fossilis* (Bl.) out of 360 specimens of *Heteropneustes fossilis* (Bl.) examined throughout the year 1993, 1994 and 1995. The fishes were procured from Barwa dam, in District Banda (U.P).

Description

Body very small, oval with rounded anterior and posterior extremities, 0.60 x 0.24. Oral sucker subterminal spherical, 0.06 in diameter. Prepharynx 0.05 in length. Pharynx oval, well developed 0.015 x 0.011. Oesophagus 0.012 in length. Intestinal caecae terminating a little anterior to hind end of the body. Acetabulum absent.

Testis single, very large, oval, intercaecal, 0.09 x 0.12. Cirrus pouch absent. Seminal vesicle bipartite. Genital sac globular situated on left intestinal caecum.

Ovary small, median, pretesticular, spherical, 0.04 - 0.05, Uterus very extensive occupying the whole

postbifurcal body, containing large, yellow, oval, filamented eggs occupying entire posttesticular region. Vitelline follicles extending from hind end of ovary to hind end of testis.

Discussion

Chen (1949) established the genus Haplorchoides with H. cahirinus (Looss, 1896) as its type species.

The question of the validity of the genera Haplorchis Looss, 1899; Monorchotrema Nishigori, 1924 and Chen, 1949 have been discussed by several authors. Witenberg (1929 and 1930), Srivastava (1935), Chen (1936) and Dawes (1946) considered the synonymy of Monorchotrema to Haplorchis.

Gohar (1934) and Dayal (1935) considered Haplorchis and Monorchotrema as distinct genera. Srivastava (1935) splitted the genus Haplorchis into two subgenera; Haplorchis (Monorchotrema) and Haplorchis (Haplorchis). The subgenus Haplorchis (Monorchotrema) is characterized in having prepharynx shorter than oesophagus, testis and vitellaria caudal in position and with a rudimentary acetabulum, while the subgenus Haplorchis (Haplorchis) is characterized in having prepharynx longer than oesophagus, testes and vitellaria more anterior and the acetabulum being absent.

Chen (1936) considered the synonymity of the genera *Haplorchis* Looss, 1899 and *Monorchotrema* Nishigori, 1924 and considered *Haplorchis* to be the only valid genus and *Monorchotrema* to be identical and synonymous to it. In 1949, he differentiated the two genera *Haplorchis* Looss, 1899 and *Haplorchoides* n.g. on the basis of relative size of prepharynx and oesophagus, a short prepharynx, long oesophagus, thin-walled vesicula seminalis and more posterior position of testis and vitellaria, Characterized *Haplorchis* while a long prepharynx, short rudimentary oesophagus and more forward position of testis and vitellaria characterized *Haplorchoides*. Yamaguti, 1954 considered *Pseudohaplorchis* Dayal, 1949 as a synonym of *Haplorchoides* Chen, 1949.

Gupta (1953), Yamaguti (1958 and 1971) and Agrawal, 1964 accepted Chen's (1949) view and considered the genus *Haplorchoides* as distinct from *Haplorchis* whereas Chatterji (1953 and 1956) and Baugh (1963) considered *Haplorchoides* as a synonym of *Haplorchis*. Later Pearson (1964) accepted this genus and placed it under the family Heterophyidae on the basis of the position and shape of excretory bladder. Rai and Pande (1967) agreed with Pearson (1964) and placed it in the sub-family *Haplorchiinae* Looss, 1899 on the basis of the presence of armed acetabulum embedded inside the ventrogenital sac and saccular and post-testicular excretory bladder. In the present study, the latter arrangement has been accepted.

Haplorchoides seenghali has been described by Dayal and Gupta (1954) from the intestine of *Mystus seenghala*. Gupta (1955) gave complete description of the species but described it as a new species.

The present specimens resemble type specimen except for smaller size of body, in principal body measurements and very large size of testis, which may be regarded as variable characters. So the specimen is described as *Haplorchoides seenghali* Dayal and Gupta, 1954.

Host : *Heteropneustes fossilis* (Bl.)

Location : Intestine

Locality : Banda (U.P).

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P A R T - III

HOST - PARASITE RELATIONSHIP

HOST-PARASITE RELATIONSHIP

Study of helminthological literature from India indicates that more attention has been paid to taxonomic studies of helminth worms. While the taxonomy forms the basis of all biological investigations, still it alone can not fulfill the objectives of parasitologists. Host-parasite relationship has to be given due weightage to assess the exact extent of damage caused by these parasites. Till now very little attention has been given to host-parasite relationship, population biology and estimation of helminth infection with regard to most of the species. These lacunae are mainly responsible for our failure in implementing our objectives and in combating helminth infections.

In order to make the faunistic studies more objective, host-parasite relationship has been studied and discussed in detail. Investigations on these relatively explored branches are bound to reveal important clues for a correct understanding of the nature and extent of their pathogenic role.

A parasite is always under the influence of two types of environments - viz; the internal environment in which the parasite lives and the external environment in which the host lives. It is the interaction of the influence of

these environments and the strategy adopted by the parasites to counter influence that develops the host specificity and host parasite relationship. Thus the establishment and survival of helminths in their hosts is controlled by the internal environment of the host as well as its external environment.

Thus the major environmental factor that influence the incidence of helminth infection and host-parasite relationship are both biotic and abiotic. In the present study various abiotic factors including - Index of total helminth infection in trematodes,host - wise analysis, overall incidence, level and intensity of parasitization, seasonal incidence have been studied and statistically analysed, similarly biotic factors like the influence of sex of the host and size of the host have also been studied.

The climate of Bundelkhand region is subtropical and four seasons which can be recognised are the Winter season (Nov., Dec., Jan., Feb.), Summer season (March, April, May, June) and Rainy season (July, Aug., Sept., Oct.).

The average atmospheric temperature ranges from 25.11°C (in Jan.) to 41.35°C (May) and minimum temperature ranges from 10.51°C (in Jan.) to 26.58°C (May). The temperature gradually shows a decreasing trend from July to December and increasing trend from January to May.

Relative humidity is more in morning (8.30 am) than in evening (5.30 pm). The minimum in morning hours was 24.90% in April while maximum 85.35% was in the month of August. In the evening the lowest humidity values were 16.50% in May and highest 85.33% in August.

Since during the present study period trematodes formed the predominant helminth parasites, hence the present study is mainly concentrated on the host-parasite relationship of trematodes. As the cestode recovered was only one, and no nematodes were reported, so they are not being statistically analysed.

Under the present project, the helminth parasites of five different host fishes viz. - *Channa punctatus* (Bl.); *Channa striatus* (Bl.); *Channa marulius* (Ham.); *H. fossilis* (Bl.) and *Clarias batrachus* (Linn.) were collected from July 1993 to June 1994 and from July 1994 to June 1995. A total of 1800 host fishes were collected and examined regularly during that period. On an average fifteen fishes of each host species (Total about 75 fishes per month) were examined. The data thus collected has been statistically analysed.

INDEX OF TOTAL HELMINTH INFECTION (TREMATODES)

INDEX OF TOTAL HELMINTH INFECTION (TREMATODES)

A total of 1800 host fishes belonging to five host species were procured during two years period from July 1993 to June 1995. The data collected was analysed to determine percentage of total helminth infection.

TABLE I

Month & Year		No. of parasite recovered	Percentage of trematode infestation
July	93-94	28	18.66
August	93-94	70	46.66
September	93-94	29	19.33
October	93-94	26	17.33
November	93-94	27	18.00
December	93-94	24	16.00
January	94-95	38	25.33
February	94-95	28	18.66
March	94-95	19	12.66
April	94-95	16	01.66
May	94-95	01	00.66
June	94-95	02	01.33

It is clear from the above Table 1 that the highest % of trematode infestation was in the month of August and lowest in the month of May and June.

It was observed from separate study of year wise incidence, that the helminth infestation was relatively less in the year 1993-94 as compared to that in 1994-95 i.e. there is a definite increase in the rate of helminth infestation during 1994-95. (Plate 14).

From the study of monthly fluctuation of trematode parasites, it is evident that the infection shows a decline during summer months prior to breeding season (May - June) and increases in rainy season. The reason for this may be that prior to breeding season, the fishes stop feeding for some time and so there is very little chance of their getting infected, but during rainy season water gets polluted, so the infestation rate is high.

HOST - WISE ANALYSIS OF PARASITES

HOST-WISE ANALYSIS OF PARASITES

Host-wise analysis of various parasites recovered has been analysed in Table 2A, 2B, 2C, 2D & 2E respectively.

Channa punctatus (Bl.)

TABLE 2-A

Parasite	Habitat	Total No. of parasites recorded during July 1993 to June 1995	Total No. of positive hosts	Month and Year in which infection was recorded
(a)	(b)	(c)	(d)	(e)
Genarchopsis singularis Srivastava, 1933	Intestine	8	4	July 1994 August 1994 December 1994 April 1995
Genarchopsis goppo Srivastava, 1933	Intestine	2	1	February 1995
Genarchopsis piscicola Srivastava, 1933	Intestine	8	4	September 1994 November 1994 December 1994 March 1995

(a)	(b)	(c)	(d)	(e)
Orientocreadium indicum Pande, 1934	Intestine	10	3	July 1993 August 1994 November 1994
Orientocreadium pseudobagri Yamaguti, 1934	Intestine	4	3	August 1993 August 1994 November 1994
Allocreadium handiai Yamaguti, 1934	Intestine	5	4	November 1993 December 1993 July 1994 April 1995
Metacercaria				
Euclinostomum heterostomum (Rudolphi, 1809) Travassos, 1928	Body cavity	4	3	July 1994 January 1995
Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911)	Body cavity	3	1	April 1994
Clinostomum complanatum (Rudolphi, 1819) Braun 1899	Body cavity	40	17	July to Dec 1993 Jan to June 1994

<u>Channa</u> <u>striatus</u> (Bl.)

TABLE 2-B

Parasite	Habitat	Total No. of parasites recorded during July 93 to June 1995	Total No. of positive hosts	Month & Year in which infection was recorded	
Genarchopsis singularis Srivastava, 1933	Intestine	2	1	October	1994
Orientocreadium indicum Pande, 1934	Intestine	6	3	July September November	1994 1994 1994
Allocreadium handiai Pande, 1937	Intestine	3	2	August April	1994 1995
Metacercaria					
Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911	Body cavity	2	1	January	1995

Channa marulius (Ham.)

TABLE 2-C

Parasite	Habitat	Total No. of parasites recorded during July 93 to June 95	Total No. of positive hosts	Month & Year in which infection was recorded
Orientocreadium indicum Pande, 1934	Intestine	3	1	August 1994
Metacercaria				
Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911	Body cavity	2	1	September 1994

Heteropneustes fossilis (Bl.)

TABLE 2-D

Parasite	Habitat	Total No. of parasites recorded during July 93 to June 95	Total No. of positive hosts	Month & Year in which infection was recorded
Orientocreadium indicum Pande, 1934	Intestine	7	3	March 1994 July 1994 November 1994
Orientocreadium pseudobagri Yamaguti, 1934	Intestine	4	2	February 1994 February 1995
Orientocreadium keni n.sp.	Intestine	2	1	January 1995
Allocreadium handiai Pande, 1937	Intestine	5	1	February 1994
Haplorchoides seenghali Dayal and Gupta, 1954	Intestine	1	1	February 1995
Phyllodistomum tripathi Motwani and Srivastava, 1961	Intestine	12	5	July 1994 August 1994

Clarias batrachus (Linn.)

TABLE 2-E

Parasite	Habitat	Total No. of parasites recorded during July 93 to June 95	Total No. of positive hosts	Month & Year in which infection was recorded
Orientocreadium indicum Pande, 1934	Intestine	127	21	Aug, Sep., Dec. 1993 Feb, Mar., Aug. Sep, Oct., Nov. December 1994 Jan, Feb., Mar April 1995
Orientocreadium pseudobagri Yamaguti, 1934	Intestine	17	8	Aug, Sep., Oct, November 1994 Jan, Feb., Mar. 1995
Orientocreadium keni n.sp.	Intestine	13	7	Jan. Feb., Aug. October 1994 Feb., March 1995
Orientocreadium batrachoides Tubangui, 1931	Intestine	2	1	April 1995
Allocreadium handiai Pande, 1937	Intestine	15	8	November 1993 Mar, Apr., Oct. 1994 Feb. Mar., Apr. 1995
Pycnadena bariliusi V. Kumari, 1973	Stomach	1	1	January 1995

Channa punctatus (Bl.). From July 1993 to June 1995, the author regularly examined fifteen fishes per month of each host species. Accordingly Channa punctatus was collected every month to procure parasites. On an average fifteen host fishes were examined per month and one hundred & eighty fishes were examined from July 1993 to June 1994 and the same number was examined in July 1994 to June 1995 (Total 360 host fishes). The number of trematodes and the month in which they were recovered were recorded. The analysis of the data has been given in (Table 2-A). This table shows that in all, Channa punctatus harboured nine trematode species including 3 metacercaria. Orientocreadium indicum was the dominant trematode species.

Channa striatus (Bl.). Fifteen host fishes per month were examined for a period of two years. The data collected has been analysed in (Table 2-B). The analysis shows that C.striatus harboured four trematode species including one metacercaria. Parasite-wise, O.indicum formed most dominant trematode species.

Channa marulius (Ham.). Channa marulius showed minimum trematode infestation during a study period of two years from July 1993 to June 1995. This species of Channa harboured only one trematode species O.indicum and one metacercaria.

- *H.fossilis* (Bl.). This air-breathing host fish harboured six trematode species including one new species with maximum number of *P.tripathi*. The new species harboured by this host is *O. keni*.

- *Clarias batrachus* (Linn.). Most commonly available cat fish, *Clarias batrachus*, harboured six different trematode species including a new species *Orientocreadium keni*.

Thus the above analysis suggests that *Channa punctatus* (Bl.) and *Clarias batrachus* (Linn.) are the most susceptible host fishes for trematode infestation.

OVERALL INCIDENCE OF TREMATODES

OVERALL INCIDENCE OF TREMATODES

Channa punctatus (Bl.)

TABLE 3-A

Parasite	No. of individuals parasitized	Parasitization rate percentage	Mean No. of parasite per host.
Genarchopsis singularis Srivastava, 1933	4	1.11	2.00
Genarchopsis goppo Srivastava, 1933	1	0.277	2.00
Genarchopsis piscicola Srivastava, 1933	4	1.11	2.00
Orientocreadium indicum Pande, 1934	3	0.833	3.33
Orientocreadium pseudobagri Yamaguti, 1934	3	0.833	1.33
Allocreadium handiai Pande, 1937	4	1.11	1.25
Metacercaria			
Euclinostomum heterostomum (Rudolphi, 1809) Travassos, 1928	3	0.833	1.33
Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911	1	0.277	3.00
Clinostomum complanatum (Rudolphi, 1819) Braun 1899	17	4.722	2.352

Channna striatus (Bl.)

TABLE 3-B

Parasite	No. of individuals parasitized	Parasitization rate percentage	Mean No. of parasite per host
Genarchopsis singularis Srivastava, 1933	1	0.277	2.00
Orientocreadium indicum Pande, 1934	3	0.833	2.00
Allocreadium handiai Pande, 1937	2	0.55	1.5
Metacercaria			
Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911	1	0.277	2.00

Channa marulius (Ham.)

TABLE 3-C

Parasite	No. of individuals parasitized	Parasitisation rate percentage	Mean No. of parasite per host
Orientocreadum indicum Pande, 1934	1	0.277	3.00
Metaceracaria			
Isoparorchis hypselobagri (Billet,1898) Odhner,1911	1	0.277	2.00

Heteropneustes fossilis (Bl.)

TABLE 3-D

Parasite	No.of individuals parasitized	Parasitization rate percentage	Mean No. of parasite per host
Orientocreadium indicum Pande, 1934	3	0.833	2.33
Orientocreadium pseudobagri Yamaguti, 1934	2	0.55	2.00
Orientocreadium keni n.sp	1	0.277	2.00
Allocreadium handiai Pande, 1937	1	0.277	5.00
Haplorchoides seenghali Dayal and Gupta, 1954	1	0.277	1.00
Phyllodistomum tripathi Motwani and Srivastava 1961	5	1.38	2.4

Clarias batrachus (Linn.)

TABLE-3 E

Parasite	No.of individuals parasitized	Parasitization rate percentage	Mean No. of parasite per host
Orientocreadium indicum Pande, 1934	21	5.83	6.047
Orientocreadium pseudobagri Yamaguti, 1934	8	2.22	2.125
Orientocreadium keni n.sp	7	1.94	1.857
Orientocreadium batrachoides Tubangui, 1931	1	0.277	2.00
Allocreadium handiai Pande, 1937	8	2.22	1.875
Pycnadena bariliusi V. Kumari, 1973	1	0.277	1.00

It is evident from the Tables 3A to 3E that O. indicum is the most predominant trematode parasite inhabiting all five host fishes; A. handiai - Parasitized four host sp. viz. C. punctatus, C. striatus, H. fossilis and C. batrachus; O. pseudobagri inhabiting three host species viz. C. punctatus, H. fossilis and C. batrachus; O. keni n.sp. parasitized two host species H. fossilis and Claria batrachus remaining parasites inhabited single host species.

Metacarcaria of I. hypsolobagri inhabited all the three species of Channa available locally, whereas other metacercaria lived in single host fish viz. Channa punctatus.

In this table, rate of parasitization and mean number of parasites per host has also been analysed.

Although the results analysed in Tables 3A, 3B, 3C, 3D and 3E give an overall picture of the incidence of trematode infestation found, they do not give an accurate picture of the level of parasitization at any given time of the year. Therefore in tables 4A, 4B, 4C, 4D and in 4E the levels of parasitization of each month of the year are given separately for the five species of host fishes.

LEVEL AND INTENSITY OF PARASITIZATION

LEVEL AND INTENSITY OF PARASITIZATION

Channa punctatus (Bl.)

TABLE 4-A

Parasite	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
(a) Mean % of fishes parasitized (Level of parasitization)												
Genarchopsis singularis Srivastava, 1933	3.33	3.33	-	-	-	3.33	-	-	-	3.33	-	-
Genarchopsis goppo Srivastava, 1933	-	-	-	-	-	-	-	3.33	-	-	-	-
Genarchopsis piscicola Srivastava, 1933	-	-	3.33	-	3.33	3.33	-	-	3.33	-	-	-
Orientocreadium indicum Pande, 1934	3.33	3.33	-	-	3.33	-	-	-	-	-	-	-
Orientocreadium pseudobagri Yamaguti, 1934	-	6.66	-	-	3.33	-	-	-	-	-	-	-
Allocreadium handiai Pande, 1937	3.33	-	-	-	3.33	3.33	-	-	-	3.33	-	-
Metacercaria												
Euclinostomum heterostomum (Rudolphi, 1809) Travessos, 1928	6.66	-	-	-	-	-	3.33	-	-	-	-	-
Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911	-	-	-	-	-	-	-	-	-	3.33	-	-
Clinostomum complanatum (Rudholphi, 1819) Braun, 1899	10.0	6.66	3.33	3.33	3.33	6.66	6.66	3.33	3.33	3.33	3.33	3.33

Parasite	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.	May	June
	(b) Mean number of parasites per host (Intensity of parasitization)											
<u>G.singularis</u> Srivastava, 1933	2.0	2.0	-	-	-	3.0	-	-	-	1.0	-	-
<u>G.goppo</u> Srivastava, 1933	-	-	-	-	-	-	-	2.0	-	-	-	-
<u>G.piscicola</u> Srivastava, 1933	-	-	2.0	-	3.0	2.0	-	-	1.0	-	-	-
<u>O.indicum</u> Pande, 1934	2.0	2.0	-	-	6.0	-	-	-	-	-	-	-
<u>O.pseudobagri</u> Yamaguti, 1934	-	1.5	-	-	1.0	-	-	-	-	-	-	-
<u>A.handiai</u> Pande, 1937	2.0	-	-	-	1.0	1.0	-	-	-	1.0	-	-
<u>E.heterostomum</u> (Rudolphi, 1809) Travassos, 1928	1.5	-	-	-	-	-	1.0	-	-	-	-	-
<u>I.hypselobagri</u> (Billet, 1898) Odhner, 1911	-	-	-	-	-	-	-	-	-	3.0	-	-
<u>Clinostomum complanatum</u> (Rudolphi, 1899) Braun, 1899	3.0	2.0	3.0	3.0	2.0	2.5	2.0	2.0	3.0	2.0	1.0	2.0

<u>*Channa striatus*</u> (Bl.)

<u>TABLE 4-B</u>

Parasite	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
	(a) Mean % of fishes parasitized (Level of parasitization)											
Generchopsis singularis Srivastava, 1933	-	-	-	3.33	-	-	-	-	-	-	-	-
Orientocreadium indicum Pande, 1934	3.33	-	3.33	-	3.33	-	-	-	-	-	-	-
Allocreadium handiai Pande, 1937	-	3.33	-	-	-	-	-	-	-	3.33	-	-
Metacercaria												
Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911	-	-	-	-	-	-	3.33	-	-	-	-	-

Parasite	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June
	(b) Mean number of parasites per host (Intensity of Parasitization)											
<u>G. singularis</u> Srivastava, 1933	-	-	-	2-0	-	-	-	-	-	-	-	-
<u>O. indicum</u> Pande, 1934	3.0	-	2.0	-	1.0	-	-	-	-	-	-	-
<u>A. handiai</u> Pande, 1937	-	2.0	-	-	-	-	-	-	-	1.0	-	-
<u>I. hypselobagri</u> (Billet, 1898) Odhner, 1911	-	-	-	-	-	-	2.0	-	-	-	-	-

Channa marulium (Ham.)

TABLE 4-C

Parasite	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl	May	June
	(a) Mean % of fishes parasitized (Level of parasitization)											
Orientocreadium indicum Pande, 1934	-	3.3	-	-	-	-	-	-	-	-	-	-
Metacercaria												
Isoparorchis hypselobagri (Billet, 1898, Odhner,1911	-	-	3.33	-	-	-	-	-	-	-	-	-

Parasite	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar.	Apl.	May	June
	(b) Mean number of parasites per fish (Intesnsity of parasitization)											
O. indicum Pande, 1934	-	3.0	-	-	-	-	-	-	-	-	-	-
I. hypselobagri (Billet, 1898) Odhner, 1911	-	-	2.0	-	-	-	-	-	-	-	-	-

Heteropneustes fossilis (B1.)

TABLE 4-D

Parasite	July	Aug	Sep	Oct	Nov.	Dec	Jan	Feb	Mar	Apl	May	June
(a) Mean % of fishes parasitized (Level of parasitization)												
Orientocreadium indicum Pande, 1934	3.33	-	-	-	3.33	-	-	-	3.33	-	-	-
Orientocreadium pseudobagri Yamaguti, 1934	-	-	-	-	-	-	-	6.66	-	-	-	-
Orientocreadium keni n.sp.	-	-	-	-	-	-	3.33	-	-	-	-	-
Allocreadium handiai Pande, 1937	-	-	-	-	-	-	-	3.33	-	-	-	-
Haplorchoides seenghali Dayal & Gupta, 1954	-	-	-	-	-	-	-	3.33	-	-	-	-
Phyllodistomum tripathi Motwani & Srivastava, 1961	6.66	10.0	-	-	-	-	-	-	-	-	-	-

Parasite	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apl	May	June
(b) Mean number of parasites per fish (Intensity of parasitization)												
O. indicum Pande, 1934	2.0	-	-	-	2-0	-	-	-	3.0	-	-	-
O. pseudobagri Yamaguti, 1934	-	-	-	-	-	-	-	2.0	-	-	-	-
O. keni n.sp.	-	-	-	-	-	-	2.0	-	-	-	-	-
A. handiai Pande, 1937	-	-	-	-	-	-	-	5.0	-	-	-	-
H. seenghali Dayal & Gupta, 1954	-	-	-	-	-	-	-	1.0	-	-	-	-
P. tripathi Motwani & Srivastava, 1961	2.5	2.33	-	-	-	-	-	-	-	-	-	-

<u>Clarias batrachus</u> (Linn.)

<u>TABLE 4-E</u>

Parasite	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
(a) Mean % of fishes parasitized (Level of parasitization)												
<u>Orientocreadium</u> <u>indicum</u> Pande, 1934	-	6.66	6.66	6.66	3.33	10.0	10.0	6.66	6.66	3.33	-	-
<u>Orientocreadium</u> <u>pseudobagri</u> Yamaguti, 1934	-	3.33	6.66	3.33	3.33	-	3.33	3.33	3.33	-	-	-
<u>Orientocreadium</u> <u>keni</u> n.sp.	-	6.66	-	-	-	-	3.33	6.66	3.33	-	-	-
<u>Orientocreadium</u> <u>batrachoides</u> Tubangui, 1931	-	-	-	-	-	-	-	-	-	3.33	-	-
<u>Allocreadium</u> <u>handiai</u> Pande, 1937	-	-	-	3.33	3.33	-	-	6.66	6.66	6.66	-	-
<u>Pycnadena</u> <u>bariliusi</u> Kumari, 1973	-	-	-	-	-	-	3.33	-	-	-	-	-

Parasite	July	Aug	Sep.	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
	(b) Mean number of parasites per host (Intensity of parasitization)											
O. *indicum* Pande, 1934	-	8.0	7.5	7.5	8.0	4.33	8.33	3.0	1.5	2.0	-	-
O. *pseudobagri* Yamaguti, 1934	-	3.0	2.5	3.0	2.0	-	2.0	1.0	1.0	-	-	-
O. *keni* n.sp.	-	2.0	-	2.0	-	-	1.0	1.0	4.0	-	-	-
O. *batrachoides* Tubangui, 1931	-	-	-	-	-	-	-	-	-	2.0	-	-
A. *handiai* Pande, 1937	-	-	-	1.0	1.0	-	-	2.5	2.0	2.0	-	-
P. *bariliusi* Kumari, 1973	-	-	-	-	-	-	1.0	-	-	-	-	-

The analysis of the above Tables (4A, 4B, 4C, 4D & 4E) shows that in Channa punctatus (Table 4A) the highest incidence of parasitization by G.singularis is found uniformly in the month of July, August, December and April; by G.piscicola the highest incidence of parasitization in September, November, December and March; Allocreadium handiai had the highest incidence of parasitization in July, November, December & April and Clinostomum complanatum metacercaria were found uniformly in all months with highest incidence of parasitization in the month of July and minimum level of parasitization during the months of September, October, November, February, March, April, May and June.

In Channa striatus (Table 4-B) the highest incidence of parasitization is found uniformly by O.indicum in the month of July, September and November.

In Channa marulius (Table 4-C) the incidence of parasitization by O.indicum is found in the month of August, by Isoparorchis hypselobagri (metacercaria) the incidence is found in the month of September.

In H.fossilis (Table 4-D) the highest incidence of parasitization by P.tripathi was found in the month of August and lowest in July.

In Clarias batrachus (Table 4-E) the highest incidence of parasitization by O.indicum was found in the month of August and lowest in November and April.

SEASONAL INCIDENCE OF PARASITES

SEASONAL INCIDENCE OF PARASITES

Channa punctatus (B1.)

TABLE 5-A

Parasites	Winter season (N D J F) (a)	(b)	Summer season (M A M J) (a)	(b)	Rainy season (J A S O) (a)	(b)
Genarchopsis singularis Srivastava, 1933	0.8325	0.750	0.8325	0.25	1.665	1.00
Genarchopsis goppo Srivastava, 1933	0.8325	0.5	-	-	-	-
Genarchopsis piscicola Srivastava, 1933	1.665	1.25	0.8325	0.25	0.8325	0.50
Orientocreadium indicum Pande, 1934	0.8325	1.5	-	-	1.665	1.00
Orientocreadium psecudobagri Yamaguti, 1934	0.8325	0.25	-	-	1.665	0.375
Allocreadium handiai Pande, 1937	1.665	0.5	0.8325	0.25	0.8325	0.50
Metacercaria						
Euclinostomum heterostomum (Rudholphi, 1809), Travassos, 1928	0.8325	0.25	-	-	1.665	0.375
Isoparorchis hypselobagri (Billet, 1898) Odhner, 1911	-	-	0.8325	0.75	-	-
Clinostomum complanatum (Rudolphi, 1819) Braun, 1899	4.995	2.125	3.3300	2.0	5.830	2.75

<u>Channa striatus</u> (Bl.)

<u>TABLE 5-B</u>

Parasites	Winter season (N D J F)		Summer season (M A M J)		Rainy season (J A S O)	
	(a)	(b)	(a)	(b)	(a)	(b)
<u>Genarchopsis singularis</u> Srivastava, 1933	-	-	-	-	0.8325	0.5
<u>Orientocreadium indicum</u> Pande, 1934	0.8325	0.25	-	-	0.8325	1.25
<u>Allocreadium handiai</u> Pande, 1937	-	-	0.8325	0.25	0.8325	0.5
Metacercaria						
<u>Isoparorchis hypselobagri</u> (Billet, 1898) Odhner, 1911	0.8325	0.5	-	-	-	-

(a) % of hosts parasitized

(b) Mean No. of parasites per host

<u>Channa</u> <u>marulius</u> (Ham.)

<u>TABLE 5-C</u>

Parasites	Winter season (N D J F)		Summer season (M A M J)		Rainy season (J A S O)	
	(a)	(b)	(a)	(b)	(a)	(b)
<u>Orientocreadium</u> <u>indicum</u> Pande, 1934	-	-	-	-	0.8325	0.75
Metacercaria						
<u>Isoparorchis</u> <u>hypselobagri</u> (Billet, 1898) Odhner, 1911	-	-	-	-	0.8325	0.5

(a) % of hosts parasitized

(b) Mean No. of parasites per host.

Heteropneustes fossilis (B1.)

TABLE 5-D

Parasites	Winter season (N D J F)		Summer season (M A M J)		Rainy season (J A S O)	
	(a)	(b)	(a)	(b)	(a)	(b)
Orientocreadium indicum Pande, 1934	0.8325	0.5	0.8325	0.75	0.8325	0.5
Orientocreadium pseudobagri Yamaguti, 1934	1.665	0.5	-	-	-	-
Orientocreadium keni n.sp.	0.8325	0.5	-	-	-	-
Allocreadium handiai Pande, 1937	0.8325	1.25	-	-	-	-
Haplorchoides seenghali Dayal and Gupta, 1954	0.8325	0.25	-	-	-	-
Phyllodistomum tripathi Motwani and Srivastava, 1961	-	-	-	-	4.165	1.275

(a) % of hosts parasitized

(b) Mean No. of parasites per host.

Clarias batrachus (Linn.)

TABLE 5-E

Parasites	Winter season (N D J F) (a)	(b)	Summer season (M A M J) (a)	(b)	Rainy season (J A S O) (a)	(b)
Orientocreadium indicum Pande, 1934	7.4975	5.915	2.4975	0.875	7.495	5.75
Orientocreadium pseudobagri Yamaguti, 1934	2.4975	1.25	0.8325	0.25	3.33	2.125
Orientocreadium keni n.sp.	2.4975	0.5	0.8325	1.0	2.4975	1.0
Orientocreadium batrachoides Tubangui, 1931	-	-	0.8325	0.5	-	-
Allocreadium handiai Pande, 1937	2.4975	0.875	3.33	1.0	0.8325	0.25
Pycnadena bariliusi V. Kumari, 1973	0.8325	0.25	-	-	-	-

(a) % of hosts parasitized

(b) Mean No. of parasites per host.

It is clear from the Table 5-A that in Channa punctatus the maximum infestation is recorded during winter season. The highest percentage of the fish, Channa punctatus parasitized by G.singularis and the highest mean number of parasites per host are in rainy season. The highest percentage of hosts parasitized by G. piscicola and the highest mean number of parasites per host occured during winter season. The highest percentage of hosts parasitized by A. handiai occurred in winter and highest mean number of parasites per host in rainy and winter season. The highest percentage of the fish, C. punctatus parasitized by Clinostomum complanatum (metacercaria) and the highest mean number of parasites per host occured during rainy season.

In Channa striatus (Table 5-B) the maximum number of parasites were recorded in rainy season. The highest percentage of hosts parasitized by O.indicum occured during winter and rainy season and the highest mean number of parasites per host during rainy season. The highest percentage of host parasitized by A. handiai occurred in summer and rainy season and highest mean number of parasites per host in rainy season.

In Channa marulius (Table 5-C) the maximum number of parasites were recorded in rainy season. The high percentage of the fish Channa marulius parasitized by O.indicum and the highest mean number of parasites per host are recorded in

rainy season. The highest percentage of the fish, *Channa marulius* parasitized was by *Isoparorchis hypselobagri* (metacercaria) and the highest mean number of parasites per host are recorded in rainy season.

In *H.fossilis* (Table 5-D) the maximum number of parasites were recorded during winter season. The high percentage of hosts parasitized by *O.indicum* occurred during winter, summer and rainy season and the highest mean number of parasites per host during summer season.

In *Clarias batrachus* (Table 5-E) the maximum number of trematodes have been recorded during the winter season. The highest percentage of fishes parasitized by *O.indicum* and the highest mean number of parasites per host occurred during winter season. The highest percentage of this fish host parasitized by *O.pseudobagri* and the highest mean number of parasites per host occured during rainy season. The highest percentage of fishes parasitized by *O. keni* n.sp. occured during winter and rainy season and highest mean number of parasites per host in summer and rainy season. The highest percentage of fishes parasitized by *A.handiai* and the highest mean number of parasites per host occured during summer season.

It is clear from the study of above tables (Table 5-A, 5-B, 5-C, 5-D, and 5-E) that seasonal incidence of parasites was higher in all host fishes during rainy season. Out of five host fishes, C.batrachus, C. punctatus, C. striatus and H. fossilis have infection in all seasons, while the least infected host fish C. marulius (Ham.) was found infected only during rainy season. Thus seasonal prevalance forms one of the major ecological factor influencing the incidence of helminth infection in host fishes.

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EXPLANATION OF LIST AND TABLES

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Fig. 2 *Allocreadium handiai* Pande, 1937 (Ventral view)

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PLATE 4

Fig. 4 *Orientocreadium indicum* Pande, 1934 (Ventral View)

PLATE 5

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PLATE 6

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PLATE 13

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PLATE 15

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PLATE 18

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PLATE 19

Fig. 19 Histogram showing the overall incidence of six species of the Trematodes in the fish, Clarias batrachus (Linn.)

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PLATE 1

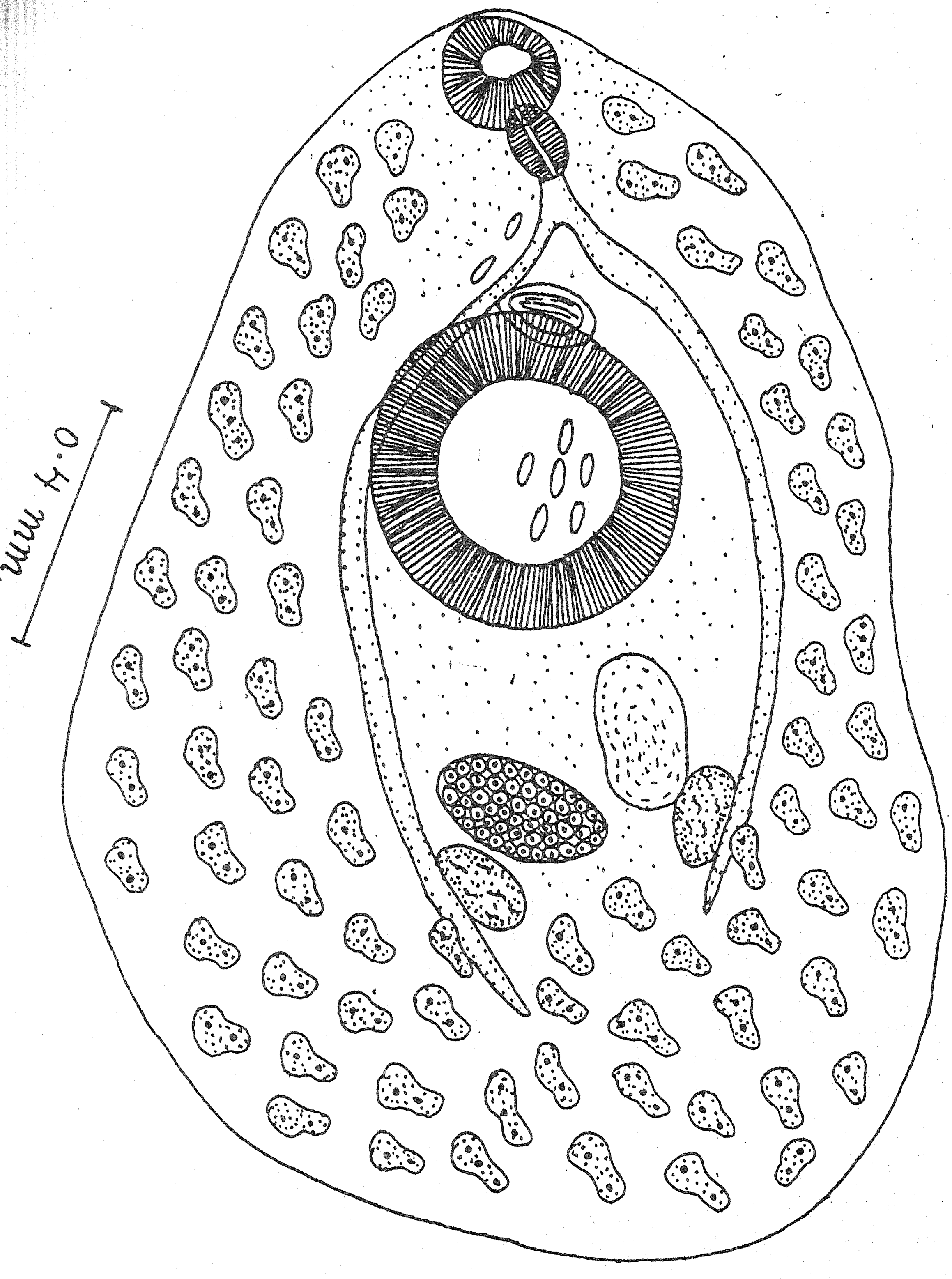


Fig. 1.

Pycnadena bariliusi Kumari, 1973; Ventral view.

PLATE 2.

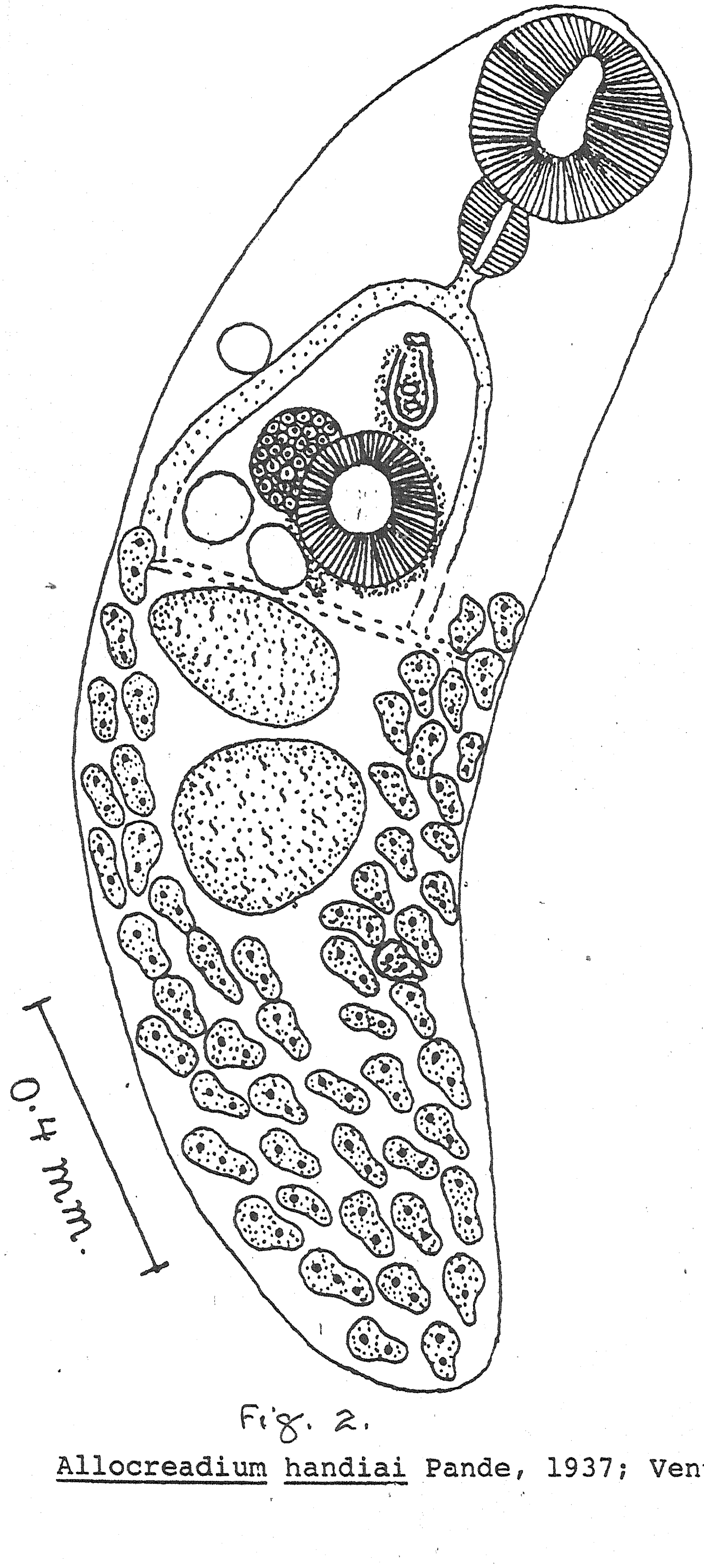


Fig. 2.

Allocreadium handiai Pande, 1937; Ventral view.

PLATE 3.

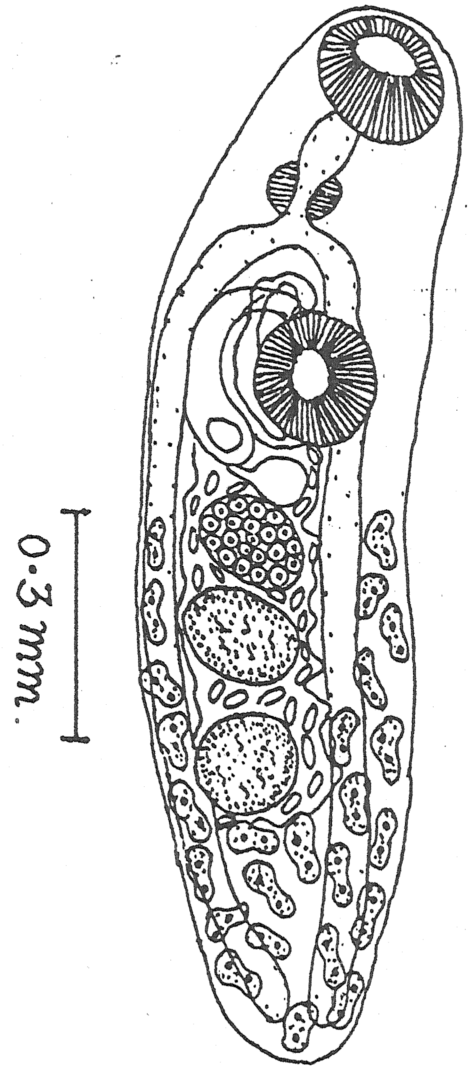


Fig. 3.

Orientocreadium batrachoides Tubangui, 1931; Ventral view

PLATE 4.

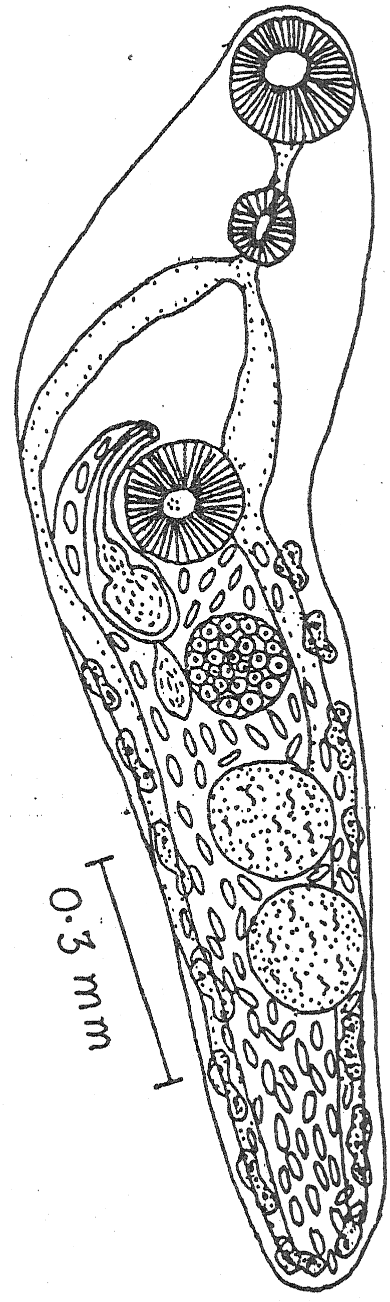


Fig. 4.

Orientocreadium indicum Pande, 1934; Ventral view

PLATE 5.

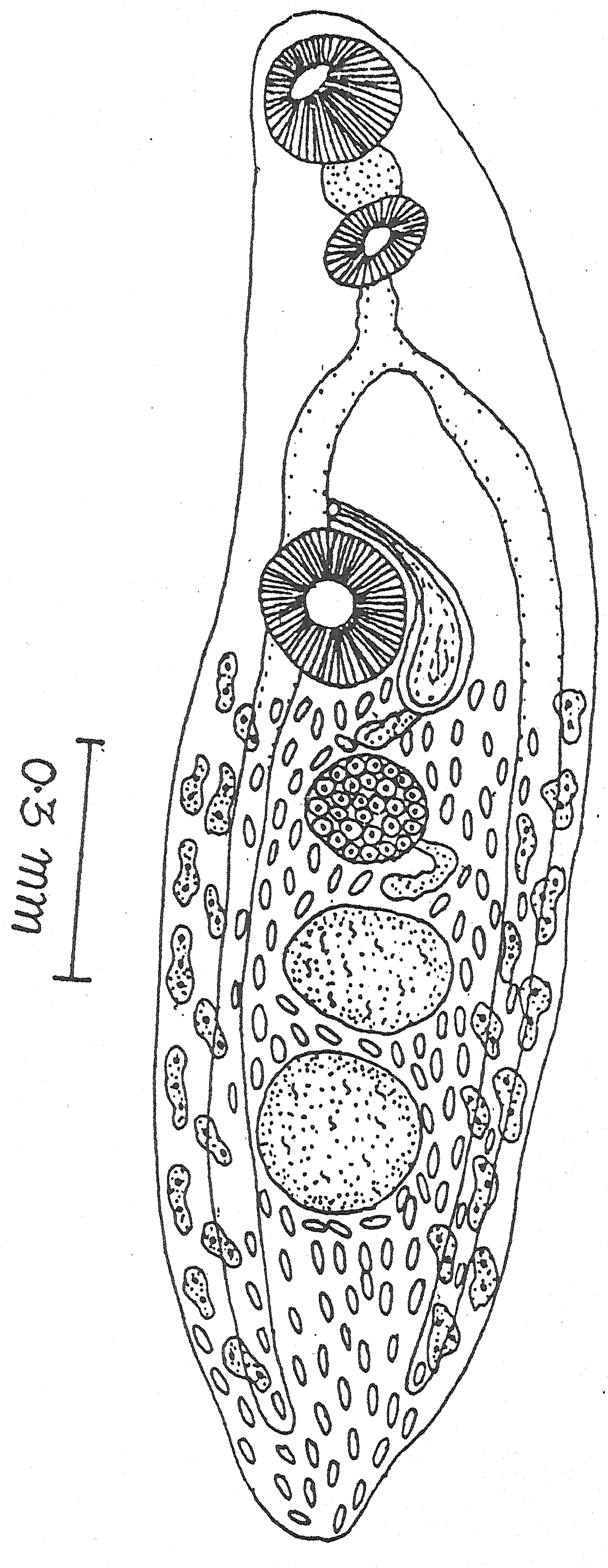


Fig. 5

Orientocreadium pseudobagri Yamaguti, 1934;Ventral view.

PLATE 6.

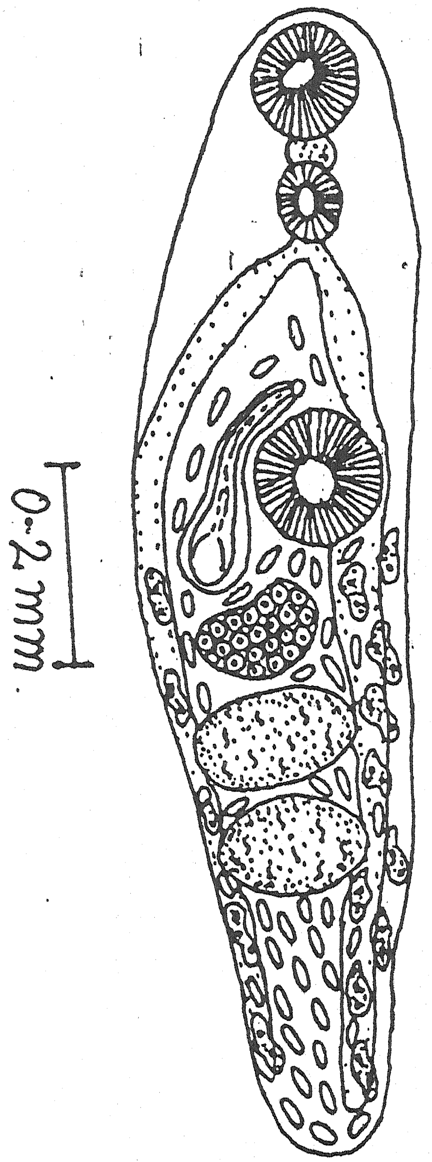


Fig. 6

Orientocreadium keni n.sp. Ventral view.

PLATE 7.

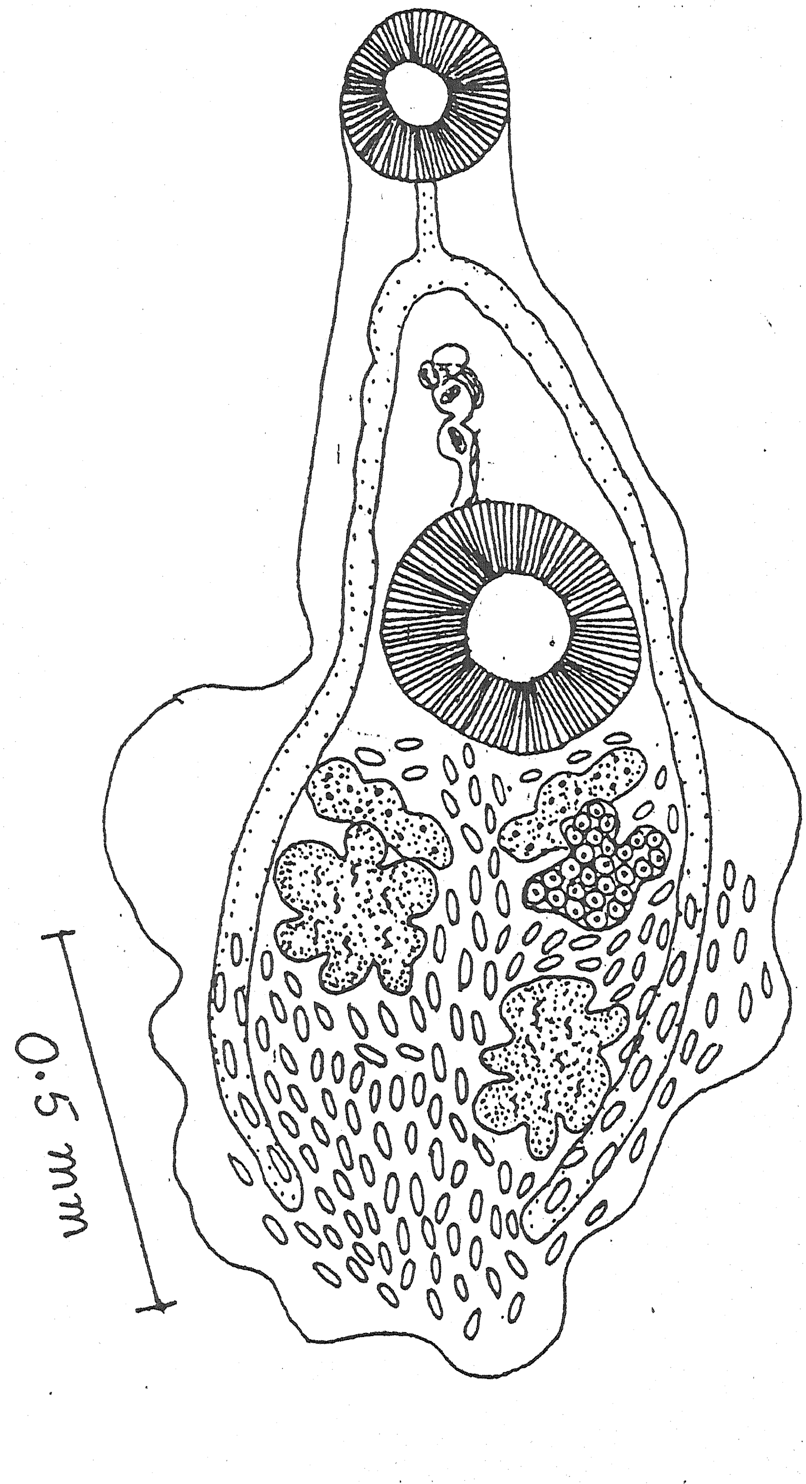


Fig. 7.

Phyllodistomum tripathi Motvani and Srivastava, 1961; Ventral view.

PLATE 8.

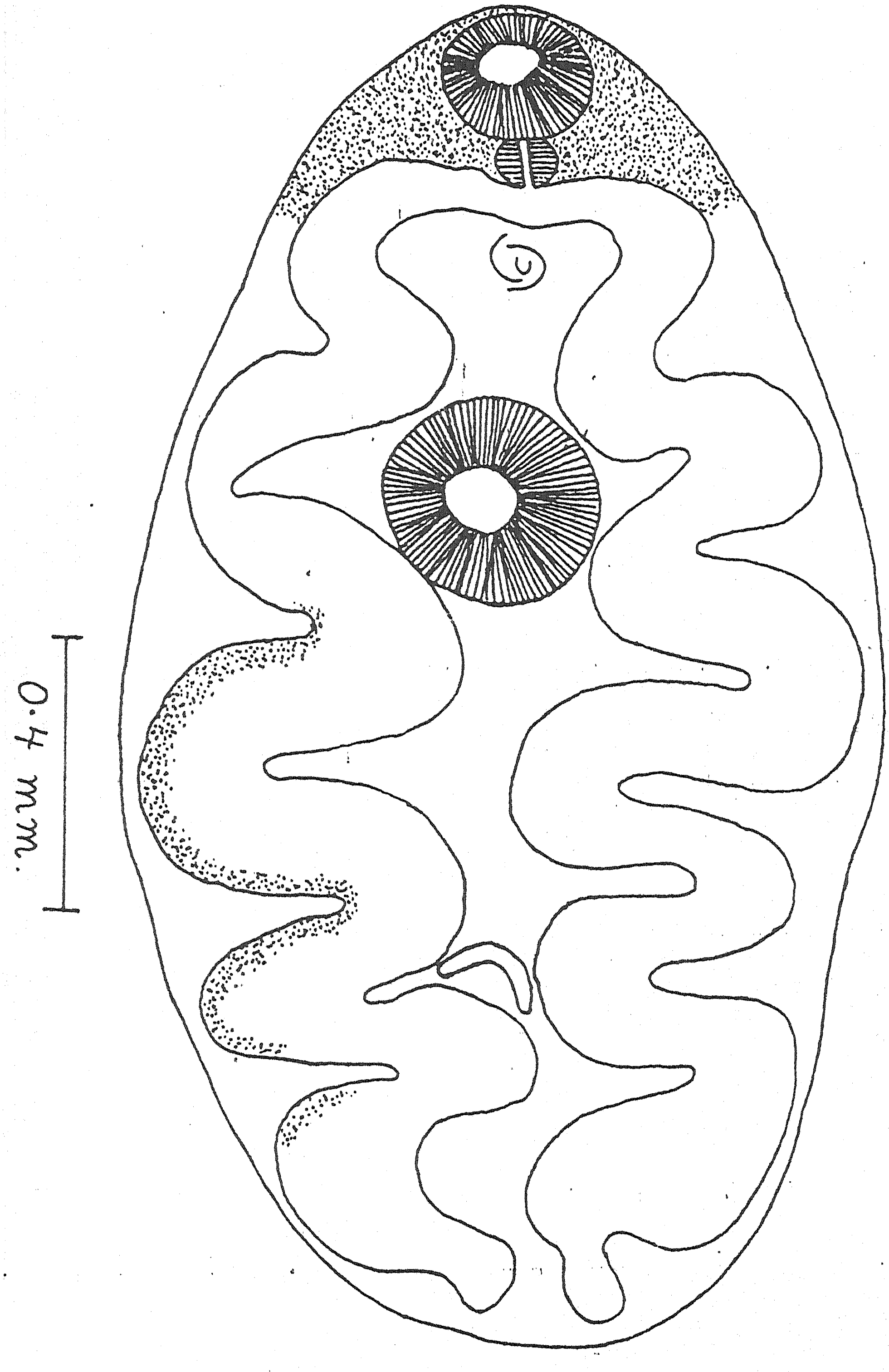


Fig. 8.

Metacercaria of Isoparorchis hypselobagri
(Billet, 1898) Odhner, 1911; Ventral view.

PLATE 9.

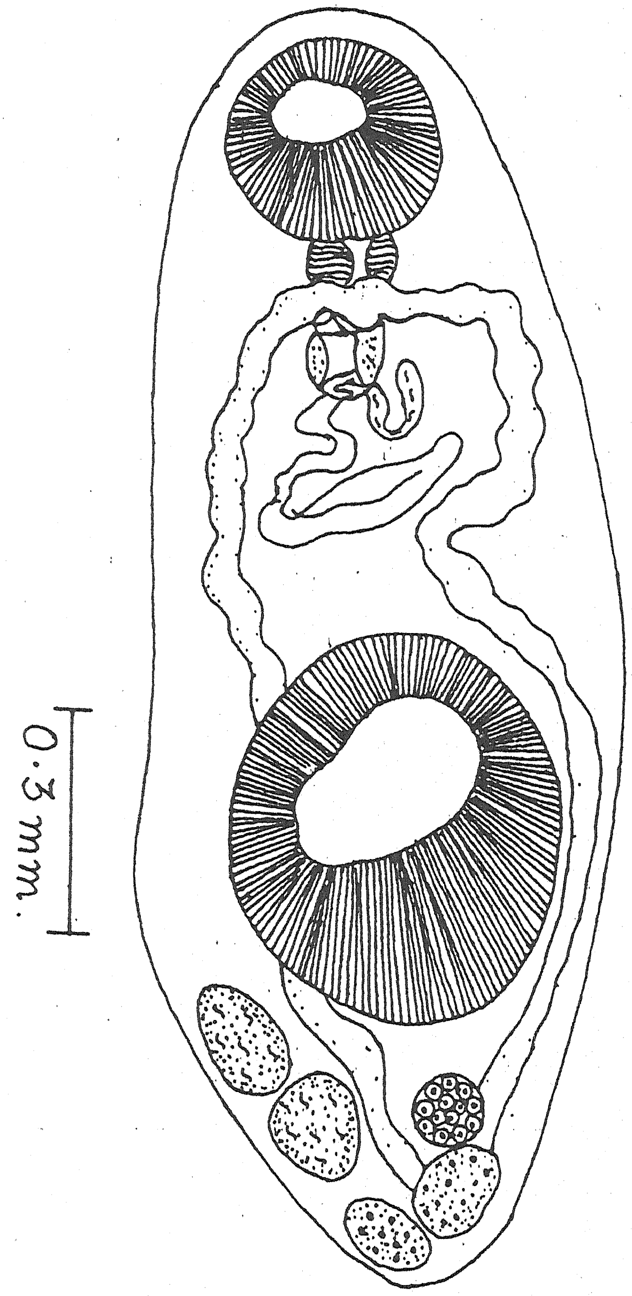


Fig. 9.

Genarchopsis piscicola Srivastava, 1933; Ventral view.

PLATE 10.

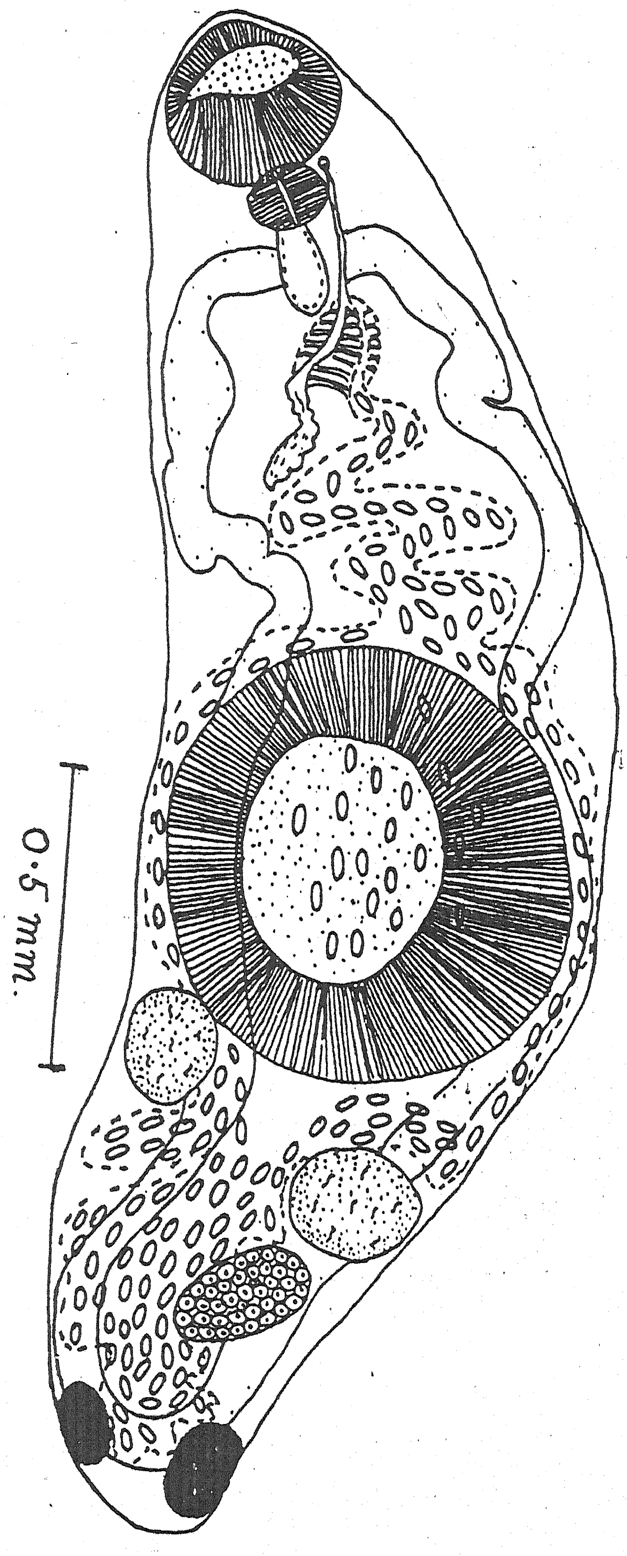


Fig. 10.

Genarchopsis goppo Srivastava, 1933; Ventral view.

PLATE 11

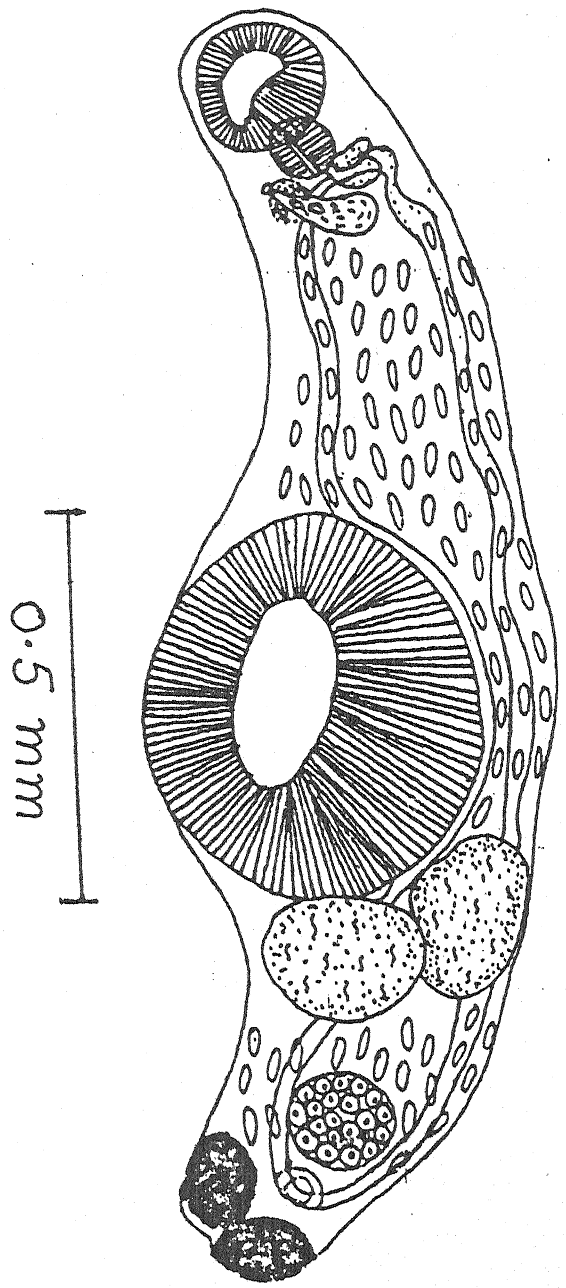


Fig. 11

Genarchopsis singularis Srivastava, 1933; Ventral view

PLATE 12.

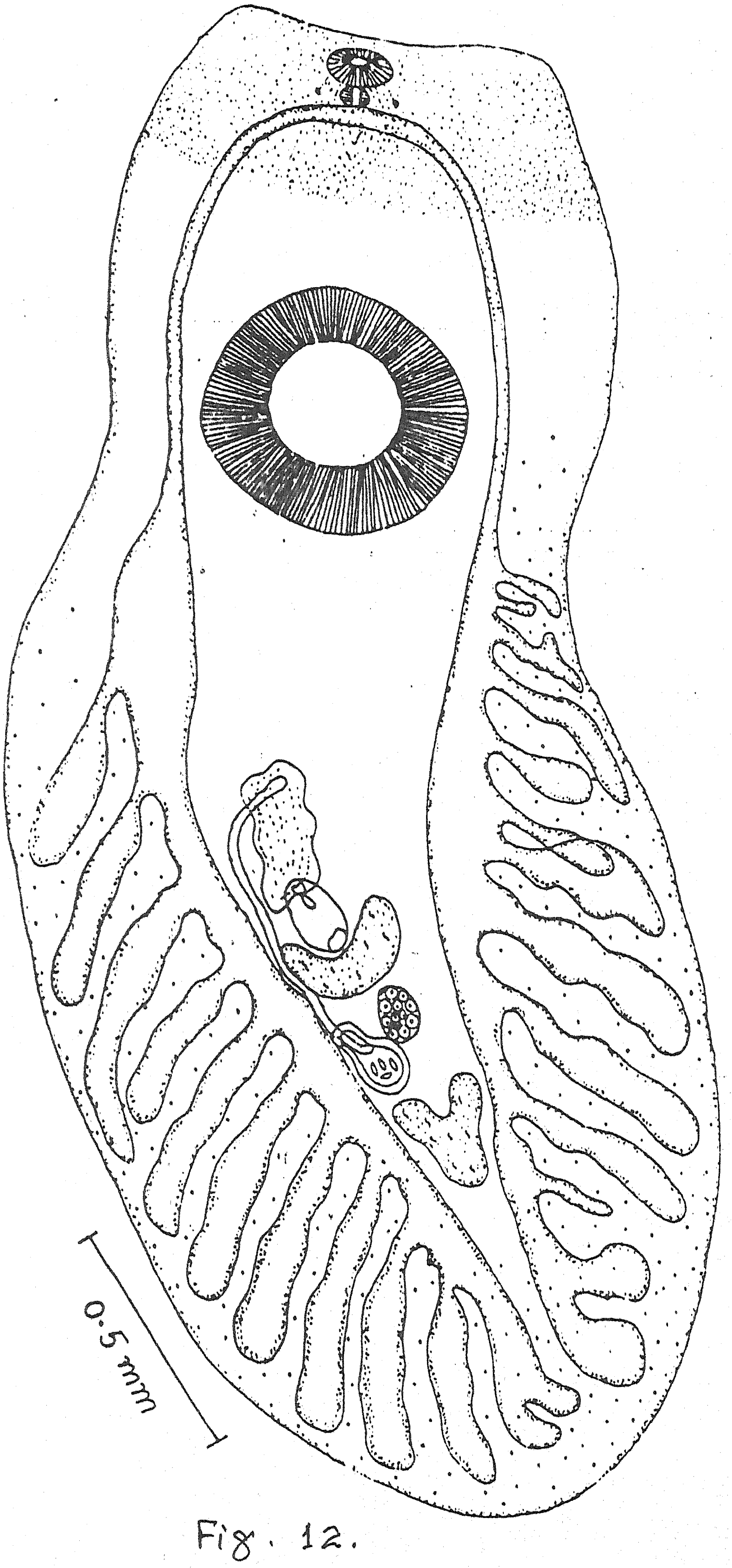


Fig. 12.

Metacercaria of Euclinostomum heterostomum

(Rudolphi, 1809) Travassos, 1928; Ventral view.

PLATE 13.

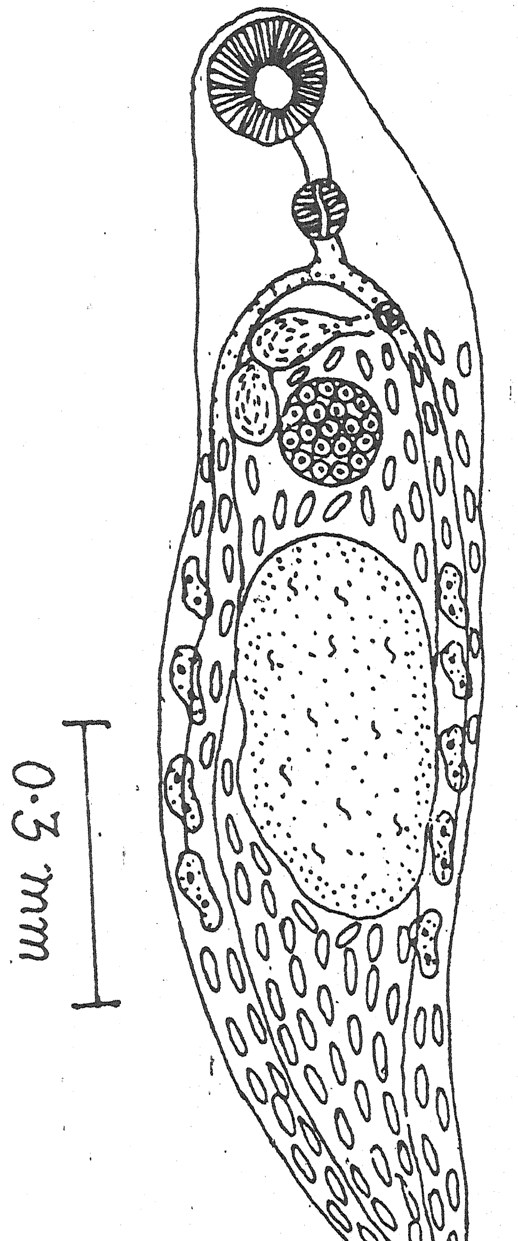


Fig. 13

Haplorchoides seenghali Dayal and Gupta, 1954

Ventral view.

PLATE 14.

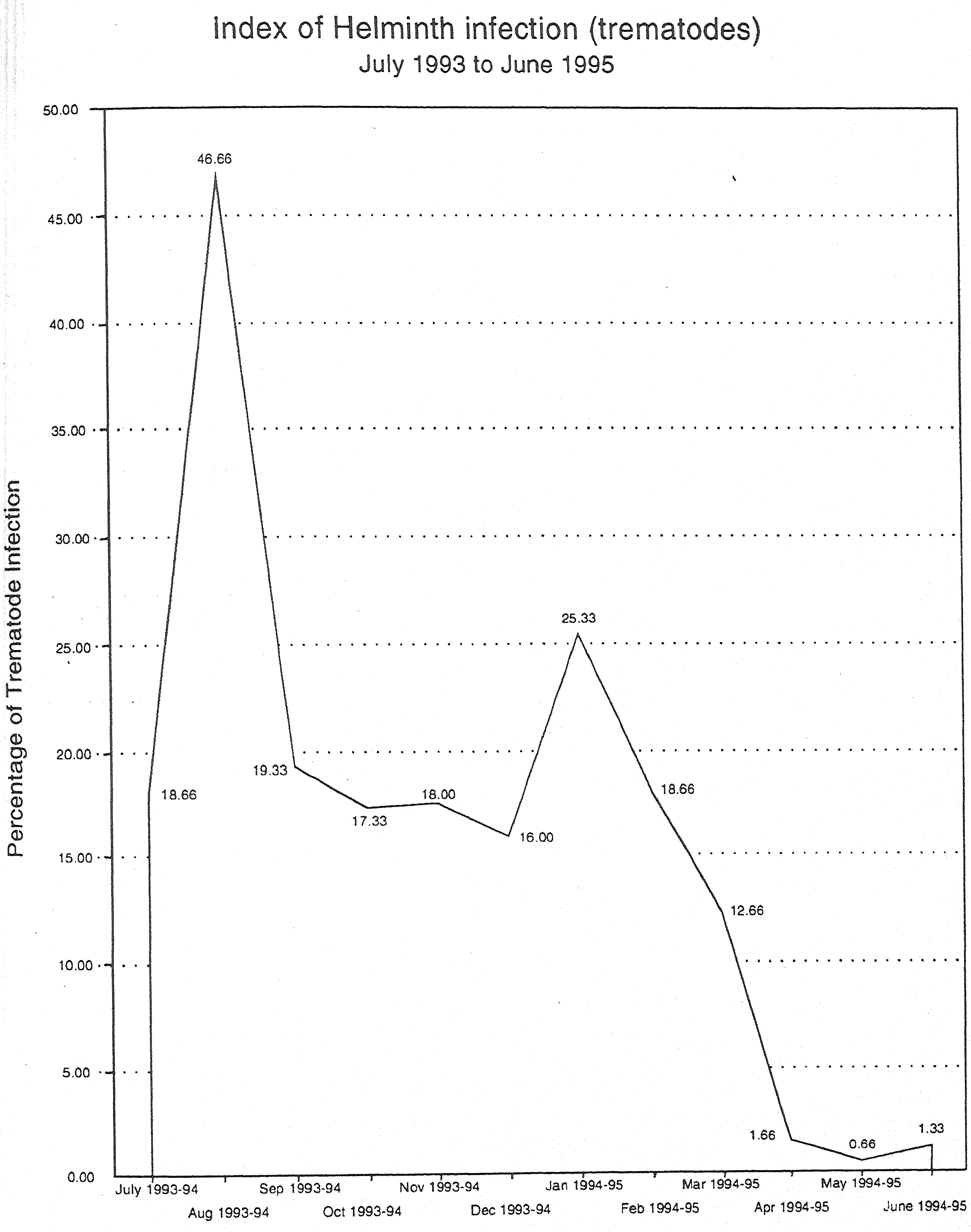
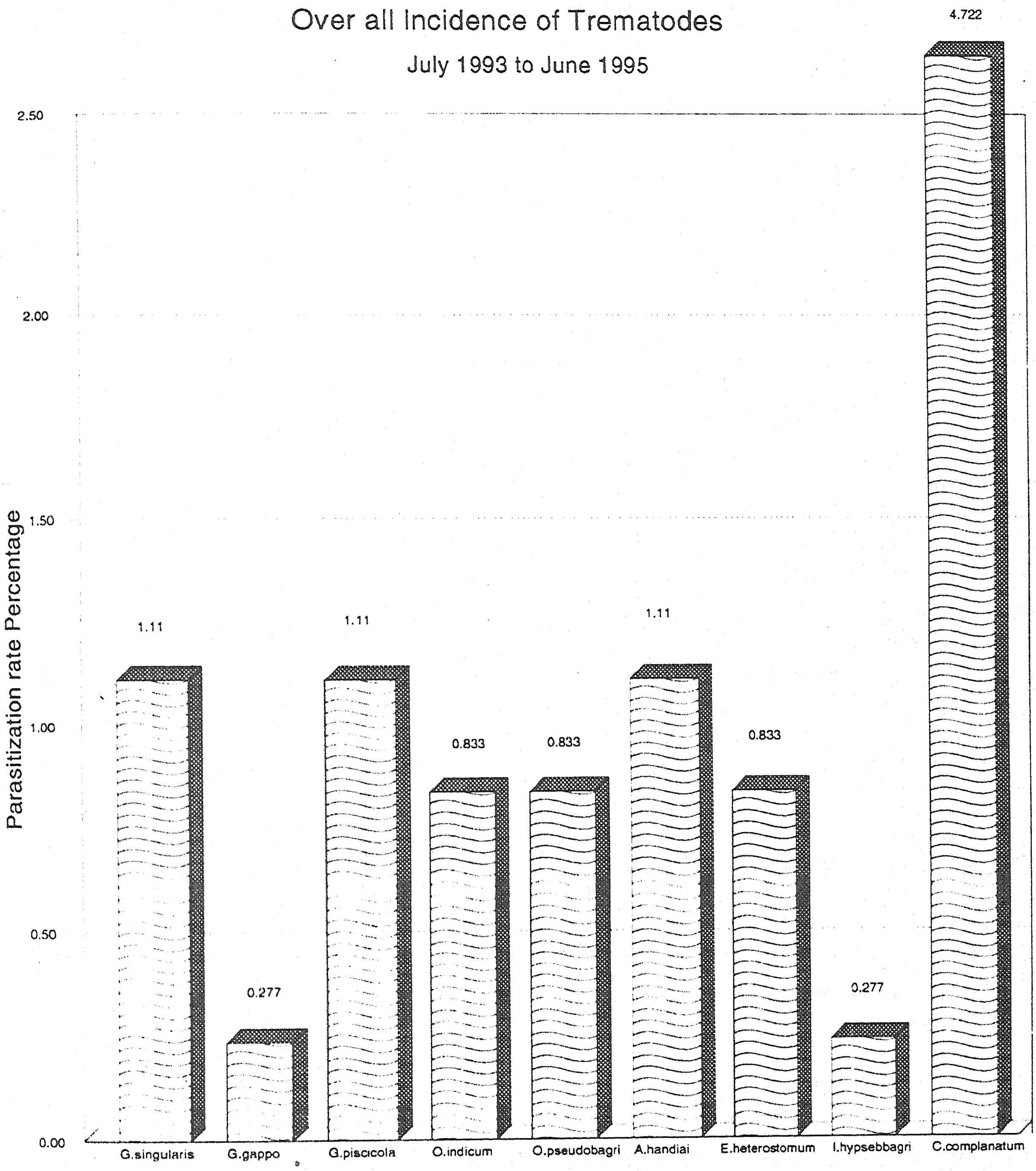


Fig. 14

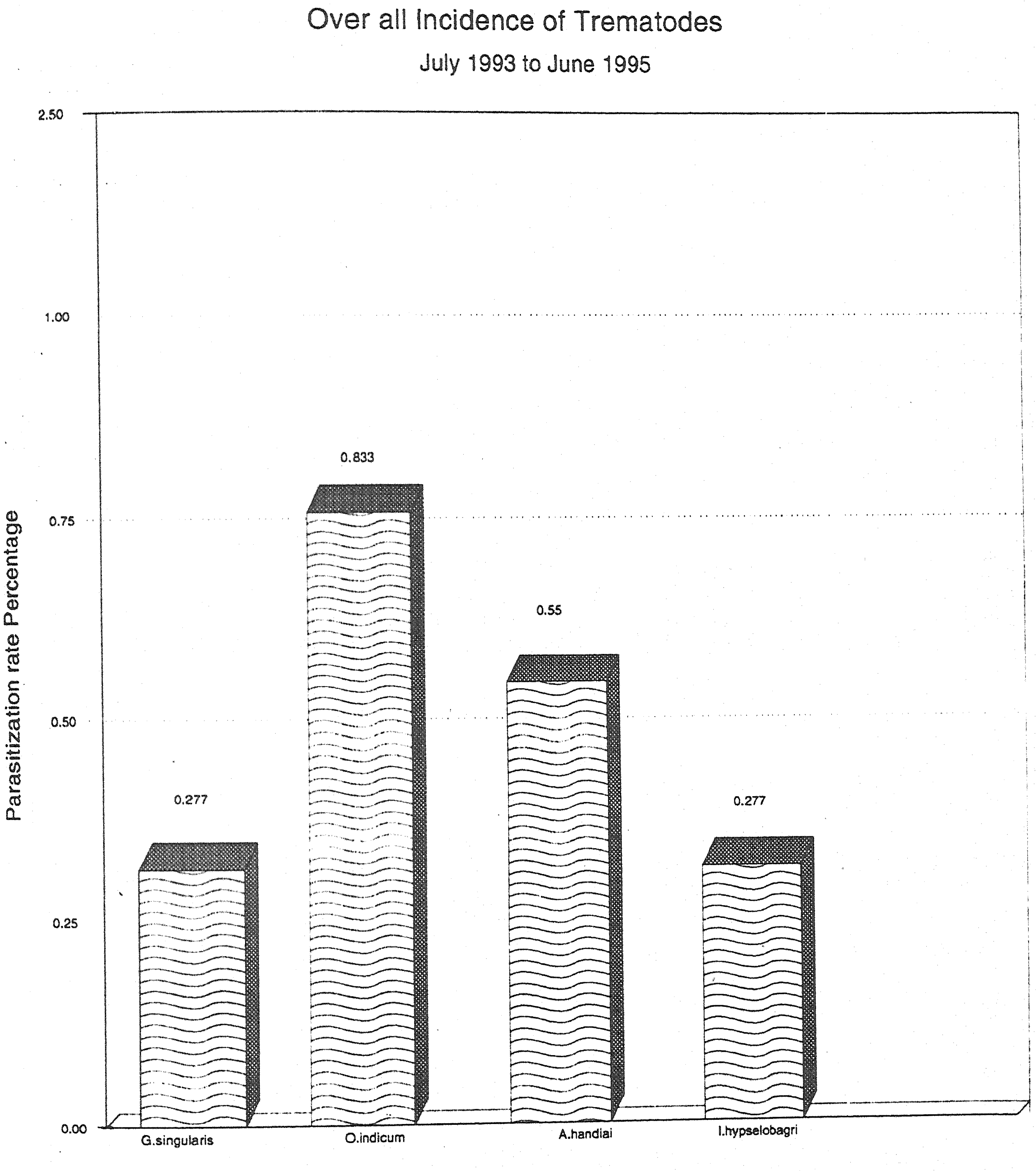
PLATE 15.



In Channa punctatus (Bl.)

Fig. 15

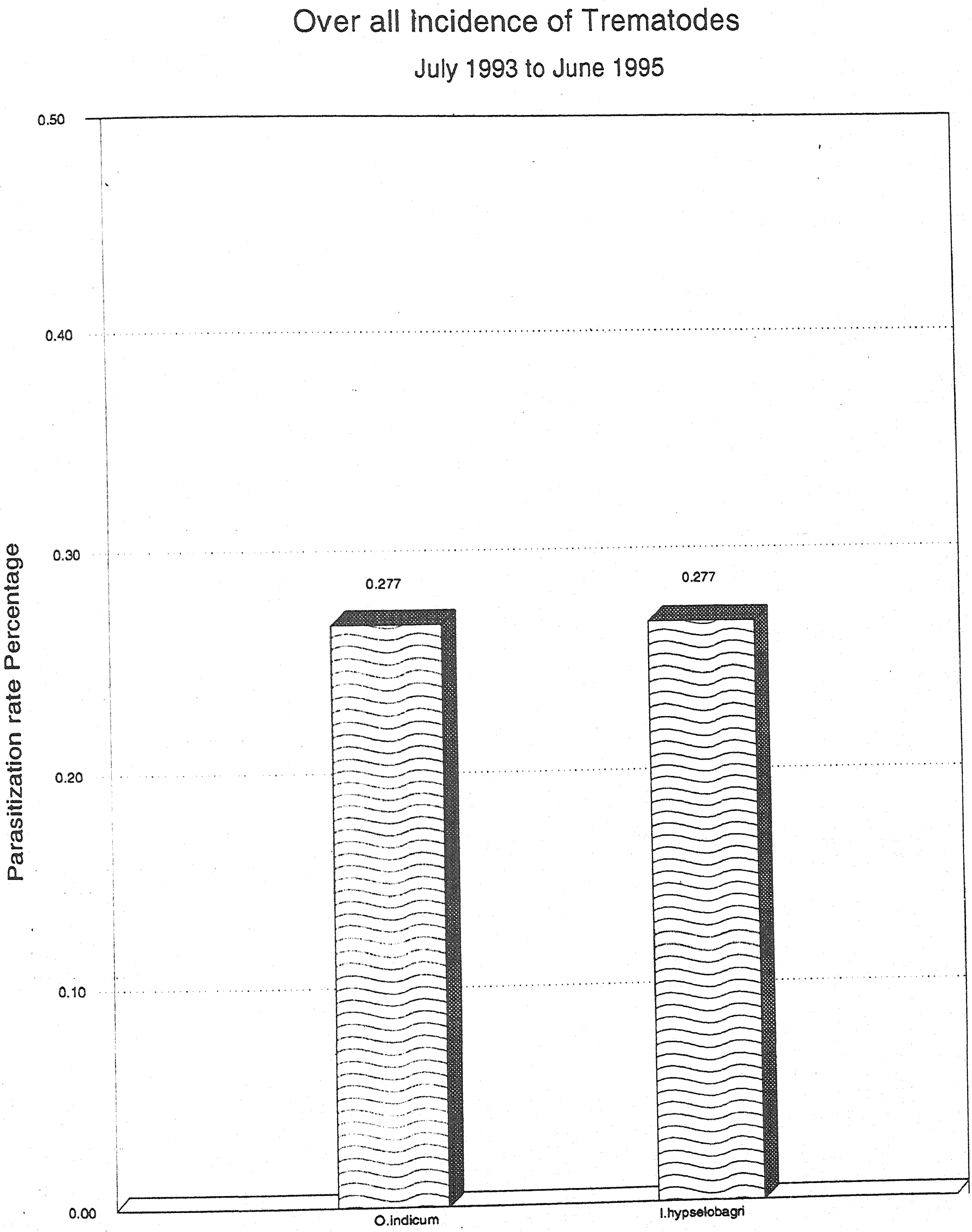
PLATE 16.



In Channa striatus (Bl.)

Fig. 16.

PLATE 17.



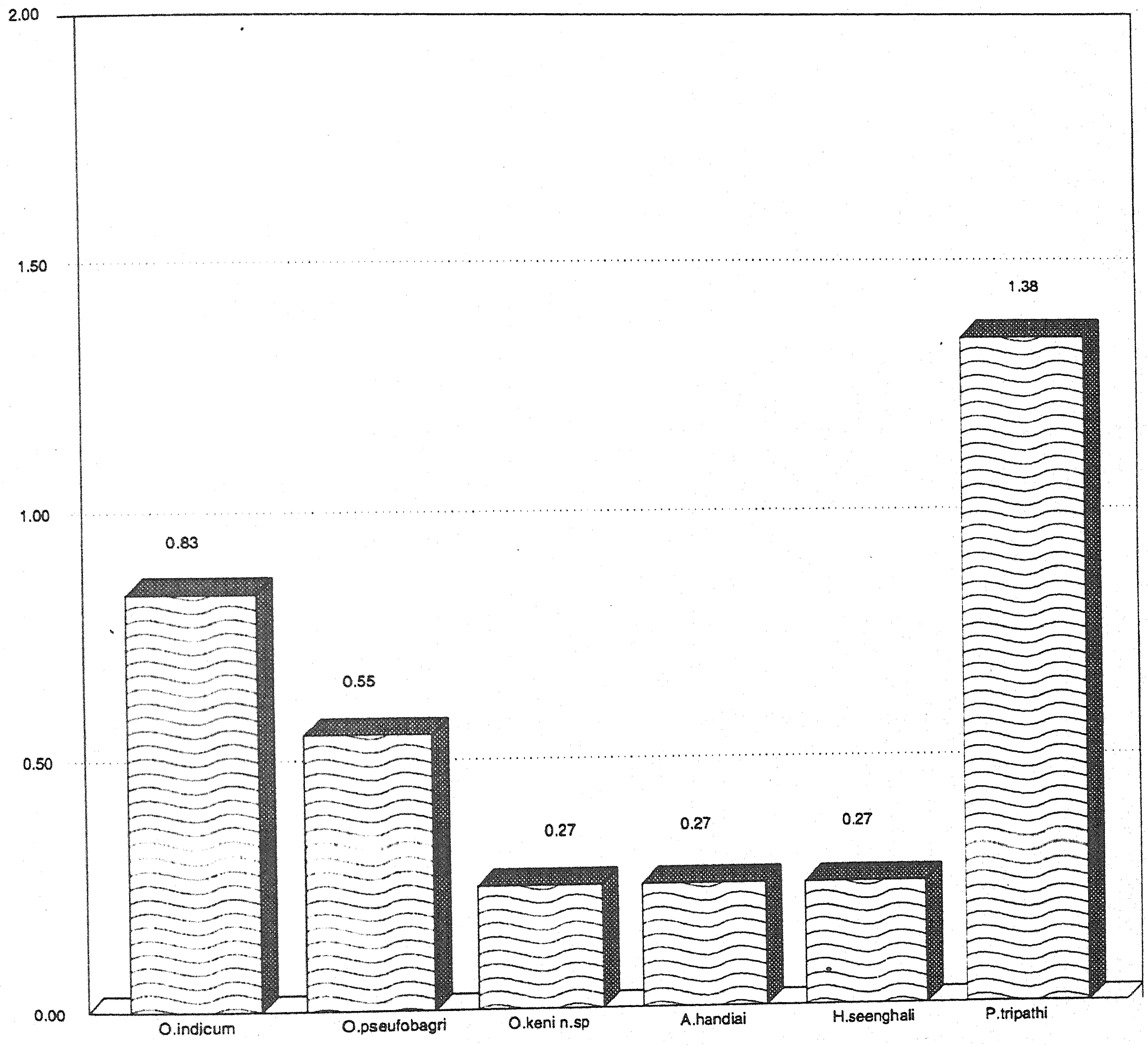
In Channa marulius (Ham.)

Fig. 17.

PLATE 18.

Over all Incidence of Trematodes

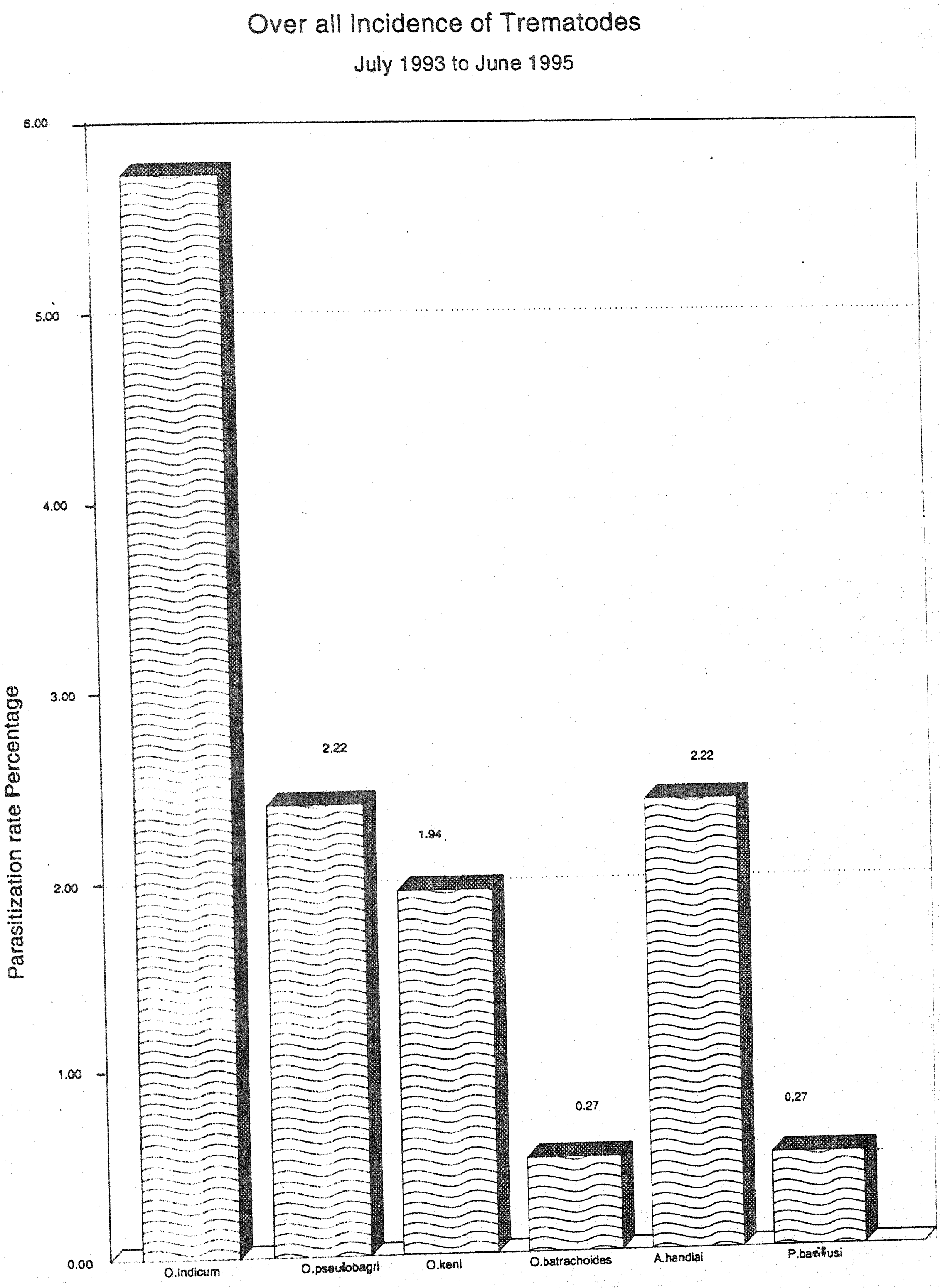
July 1993 to June 1995



In <u>Heteropneustes</u> <u>fossilis</u> (Bl.)

Fig. 18.

PLATE 19.



In Clarias batrachus (Linn.)

Fig. 19.

S U M M A R Y

SUMMARY

To investigate helminth fauna from some fresh water fishes of Bhundelkhand region, the author under the present project has planned to examine five host species of fresh water air-breathing fishes, most commonly available in this region. These fishes include Clarias batrachus (Linn.); H. fossilis (Bl.) and Channa sp. namely Channa punctatus (Bl.) Channa striatus (Bl.) and Channa marulius (Ham.). Out of five species of Channa available from Uttar Pradesh viz - Channa gachua (Ham.); Channa leucopunctatus (Bl.); Channa striatus (Bl.); Channa punctatus (Bl.) and Channa marulius (Ham.) only above mentioned three species were available from water bodies of Bundelkhand region, including Jhansi, hence they have been included in the present study. These fishes were collected regularly from Upper Dam, Lower Dam, Chuna bhatti tank, Kolas pond and other fresh water bodies in and around Jhansi and from local fish markets for a period of two years from July 1993 to June 1995. On an average fifteen fishes of each species (Total 75 fishes per month) were collected, examined and dssected. A total of 1800 fishes were examined during a period of two years. A thorough search was done to collect the parasites from various organs of fishes.

Soon after collection the trematodes were studied alive to observe spines or papillae if any, excretory system and genital opening. They were then fixed in 5-10% formaline, after fixation and thorough washing in water, worms were dehydrated in alcoholic series, then stained in borax carmine, cleared in xylene and finally mounted in DPX.

For preparing whole mount of trematodes, the worms were relaxed in fresh water for some time. The body was gently stretched by adding luke warm water. Specimens were kept in 5 - 10% formaline overnight, then washed with water, kept in alcoholic series, stained in acetoalum carmine, cleared in clove oil and finally mounted in canada balsum/DPX.

The work incorporated in the present thesis is divided into three parts.

Part I deals with introduction, historical resume, material and method, a systematic list of host examined, host-parasite list and parasite-host list.

Part II deals with the taxonomic grouping of thirteen trematodes including three metacercarial forms recovered during the study period. Mention has not been made of nematodes or cestodes as these were

not the part of project. Out of these trematode species, one species has been described as new species where as remaining ten are redescribed in detail, furnishing further information and observations which were essential to enrich our knowledge on these parasites. They are known forms but majority of these form the first host and locality record. These trematodes belong to eight families of the order Digenea and include :

1. Pycnadena bariliusi Kumari, 1973 has been described from the stomach of Clarias batrachus (Linn.). It is characterised by long hind body, symmetrical testes, posttesticular extension of uterus and embryonated eggs with occulate miracidia and absence of postoral ring.

It forms the first host and locality record.

2. Allocreadium handiai Pande, 1937 has been recorded from the intestine of four host species excluding Channa marulius (Ham.). It is characterised by the shape of the body, acetabulum smaller than oral sucker, tandem testes and small ovary attached to acetabulum.

It is the first host and locality record from Bhundelkhand region.

3. <u>Orientocreadium</u> <u>batrachoides</u> Tubangui, 1931 has been collected from the intestine of <u>Clarias</u> <u>batrachus</u> (Linn.). It is characterised by receptaculum seminis, pretesticular, equatorial ovary and postequatorial testes. Vesicula seminalis externa is long and saccular.

This recorded form has been described from this region.

4. <u>Orientocreadium</u> <u>indicum</u> Pande, 1934 has been described from the intestine of all the five host species under the present project. It is characterised by the presence of spined cirrus and metraterm, spherical ovary, vitellaria extending from posterior margin of acetabulum to posterior end of body and the follicles of two sides meet without forming lattice.

It forms the first host and locality record.

5. <u>Orientocreadium</u> <u>pseudobagri</u> Yamaguti, 1934 has been recorded from the intestine of two host species viz - <u>Clarias</u> <u>batrachus</u> (Linn.) and <u>Heteropneustes</u> <u>fossilis</u> (Bl.). It is characterised by oval oral sucker, small prepharynx, long oesophagus and extension of vitellaria halfway between the caudal testis and posterior tip of the body and cirrus pouch on the right side of acetabulum instead of overlaping it.

It forms the first host and locality record.

6. Orientocreadium keni n.sp. has been collected from the intestine of two host species viz Clarias batrachus (Linn.) and Heteropneustes fossilis (Bl.). This new species is characterised by small body, transversely elongated ovary and testes, very small oesophagus and eggs rounded or oval.

It forms the first host and locality record.

7. Phyllodistomum tripathi Motwani and Srivastava, 1961 has been recorded from the intestine of Heteropneustes fossilis (Bl.). It is characterised by acetabulum distinctly larger than oral sucker, wavy margins having thick folds along with margins, flask shaped body, divisible into a narrow, tubular fore body and a foliate hind body. Prepharynx and pharynx absent, deeply lobed testes, cirrus sac absent, lobed ovary, overlaps the right vitellaria. Receptaculum seminis absent, vitellaria two lobed glands.

It forms the first host and locality record.

8. Isoparorchis hypselobagri (Billet, 1898) Odhner 1911 has been recorded from the body cavity of all the three host species of Channa (Bl.). It is characterised by body with thick cuticle, intestinal caeca long and serpentine. Acetabulum large than oral sucker.

This recorded form has been described from this region.

9. Genarchopsis piscicola Srivastava, 1933 has been recorded from the intestine of Channa punctatus (Bl.). It characterised by small and fusiform body. Oral sucker cuplike, acetabulum large and well developed, prepharynx and oesophagus absent. Cirrus sac absent, uterine coils intercaecal, extending posteriorly upto the hind border of the testes.

This recorded form has been described from Bhundelkhand region.

10. Genarchopsis goppo Srivastava, 1933 has been collected from the intestine of Channa punctatus (Bl.). It is characterised by elliptical shape of the body, acetabulum large and spherical. Cirrus sac absent. Vesicula seminalis well developed, vitellaria two lobed glands.

It forms the first host and locality record.

11. Genarchopsis singularis Srivastava, 1933 has been described from the intestine of Channa punctatus (Bl.) and Channa striatus (Bl.). It is characterised by small oesophagus, symmetrical testes, cirrus sac absent and two compact vitellaria.

The parasite forms the first host and locality record.

12. Euclinostomum heterostomum (Rudolphi, 1809) Travassos, 1928 has been collected from the body cavity of Channa punctatus (Bl.). It is characterised by presence of well developed pharynx and vitellaria, body large with collar like formation at anterior end. Intestinal caeca very thin upto posterior border of acetabulum with lateral diverticulae. Vitelline follicles very small and immature.

This recorded form has been described from this region.

13. Clinostomum complanatum (Rudolphi, 1819) Braun,1899 simple record of this metacercaria is mentioned. This metacercaria was recovered in large numbers throughout the study period from July 1993 to June 1995 from the body cavity of Channa punctatus (Bl.).

14. Haplorchoides seenghali Dayal and Gupta, 1954 has been recorded from the intestine of H.fossilis (Bl.). It is characterised by small size of body, large size of testis, absence of cirrus pouch and acetabulum.

It forms the first host and locality record.

Part III deals with host parasite relationship. An attempt has been made to correlate various ecological factors-biotic and abiotic,affecting host-parasite relationship. The data collected for a period of two years from

July 1993 to June 1995 has been statistically analysed to study index of total helminth infection, host-wise analysis, overall incidence, level and intensity of parasitization, seasonal incidence, incidence of infection in relation to sex, co-relation between the size and sex of fish and intensity of infection in trematodes.

In the end of thesis, the references of the literature cited are given. Further, a brief 'Summary' of the work done and included in the thesis is also added in the end.

The present thesis extends over 173 pages and is illustrated with thirteen plates containing camera lucida diagrams of the trematode species described. Beside this one graph and five histograms are also given. All these figures are original and drawn by the author. The thesis includes two 'Lists' and 20 Tables which presents the datas collected during the entire work.

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